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A review of western north Atlantic species of *Bembrops*, with descriptions of three new species, and additional comments on two eastern Atlantic species (Pisces: Percophidae)

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Abstract.—The Atlantic members of the genus *Bembrops* were examined from approximately 700 specimens. Meristic, morphometric, and pigment characters were used to redescribe six species, *B. anatirostris*, *B. gobioides*, *B. greyi*, *B. heterurus*, *B. macromma*, and *B. magnisquamis*. Three species, *Bembrops ocellatus*, *B. quadrisella*, and *B. raneyi* are described as new. New information on sexual dimorphism, the cephalic canal system and vertebral number is presented. Distribution maps for all nine species are shown. *Bembrops ocellatus* and *B. quadrisella* are widespread in the Caribbean Sea. *Bembrops raneyi* is known only from the Bahama Islands. The three new species are illustrated.

The American members of the genus *Bembrops* were reviewed by Ginsburg (1955); three of the four species he described as new; in addition, he reviewed the literature and characterized the family Percophidae (=Percophididae). The family was also characterized by Grey (1959) and detailed descriptions of *B. anatirostris*, *B. gobioides*, and *B. macromma* were presented, along with figures of *B. anatirostris* and *B. macromma*.

More recently, Das & Nelson (1996) presented a world-wide revision of the percophid genus *Bembrops*, recognizing a new species from the eastern Atlantic. They reviewed the eighteen nominal species in the genus, relegating five into synonymy.

A wealth of unstudied material of the various species is available from Cornell University (CU); Tulane University, Museum of Natural History (TU); University of Florida (UF); and United States National Museum (USNM) and we present additional data on the four species known to Ginsburg, plus data on two eastern Atlantic species, and describe three new species from the western north Atlantic.

During this study we have become aware that much remains to be done in systematics, life history, sexual dimorphism, and distribution of the species within the genus *Bembrops*. We intend to pursue the study of Atlantic populations and expand our study to include related Indian and Pacific Ocean species. However, because of practical considerations the main purpose of this paper is to provide names for the three new forms.

We follow Ginsburg's (1955) placement of *Bembrops* in the family Percophidae (=Percophididae). Future research may prove the necessity of elevating the subfamily Bembropinae (Nelson 1976, 1984, 1994) to family status. The new species described herein fit the characters for the family and genus as given by Ginsburg (1955), Nelson (1976, 1978, 1984, 1994) and Das & Nelson (1996).

Methods and Materials

Ginsburg (1955) pointed out the difficulties involved in studying the species of

Bembrops because most are captured in bottom trawls and often specimens suffer broken fin rays and loss of some or most of their body scales. Difficulties in measuring and making some counts are increased when specimens have twisted, contorted bodies, and widely flared branchiocranial structures. Some of our lateral-line scale counts are estimates based on counts of scale "pockets" and some of the variation presented in the morphometrics is due to the use of distorted specimens.

We follow Ginsburg (1955) and Hubbs & Lagler (1958, 1964) in fin ray and gill raker counts. We counted rudimentary elements on both upper and lower limbs of the first left gill arch, and the raker at the angle of the arch was included in the count of the lower limb. Although Das & Nelson (1996) cited Hubbs & Lagler (1964) in their Methods and Materials section, our gill raker and fin ray counts do not always agree.

Depth of body was measured at the origin of first dorsal fin. Caudal peduncle was measured at its least depth. The head was measured from the anterior point of the rounded lobe near the end of the snout rather than from the indented midpoint to the posterior end of the extended fleshy opercle. The snout was measured from this same point to the anterior rim of the orbit. The eye (orbit) was measured horizontally between the most anterior and posterior fleshy rims of the orbit. The interorbital measurement is the least bony interorbital distance. Upper jaw length was measured from its anterior tip to the bony posterior tip of maxilla (not including tentacle). The lower jaw measurement was interpreted as the distance between anterior tip of dentary to the posterior bony tip of maxilla (not including tentacle).

Left and right tentacles are seldom of equal length and so we measured both whenever feasible, especially for species of which we had few specimens. The tentacles are quite elastic and before measurement each tentacle was gently stretched straight with a fine forceps, allowed to contract, then measured.

Pigmentation patterns in the first dorsal fin were determined for the nine Atlantic species of *Bembrops* included in our study (Fig. 1). Pigmentation on other fins and on body is also described.

Vertebral counts were made from radiographs of 333 specimens taken primarily by the Radiology Department, Louisiana State University School of Veterinary Medicine.

Counts were made on 113 *Bembrops anatirostris*, 178 *B. gobioides*, 60 *B. greyi*, 75 *B. heterurus*, 67 *B. macromma*, 8 *B. magnisquamis*, 39 *B. ocellatus*, 123 *B. quadrisella*, and 29 *B. raneyi.*

Measurements were made on 50 *B. anatirostris*, 50 *B. gobioides*, 62 *B. greyi*, 50 *B. heterurus*, 45 *B. macromma*, 6 *B. magnisquamis*, 14 *B. ocellatus*, 16 *B. quadrisella*, and 19 *B. raneyi.* Proportional measurements were made with a needle-point dial calipers and recorded to the nearest 0.1 mm.

Meristic data are presented in Tables 1-4 and morphometrics are presented in Tables 5-10. In Tables 5-7 and 10 the proportional measurements are expressed in thousandths of standard length (SL). Table 8 shows frequency distributions of ratios of head width divided by head depth, Table 9 contains frequency distributions of snout length divided by orbit length. Table 11 presents a summary of typical fin pigmentation patterns for the nine Atlantic species with sexual dimorphism noted.

We investigated the full extent of the cephalic portion of the lateral-line sensory system, which was only briefly mentioned by Ginsburg (1955) and Grey (1959). The supracleithrum and posttemporal bone were dissected from the right side of five species (*B. anatirostris*, *B. gobioides*, *B. greyi*, *B. heterurus*, and *B. macromma*) and measured, and expressed as percent of SL. The connection of the cephalic canal system to the lateral-line was examined to determined to what degree the canal is enclosed by bone.

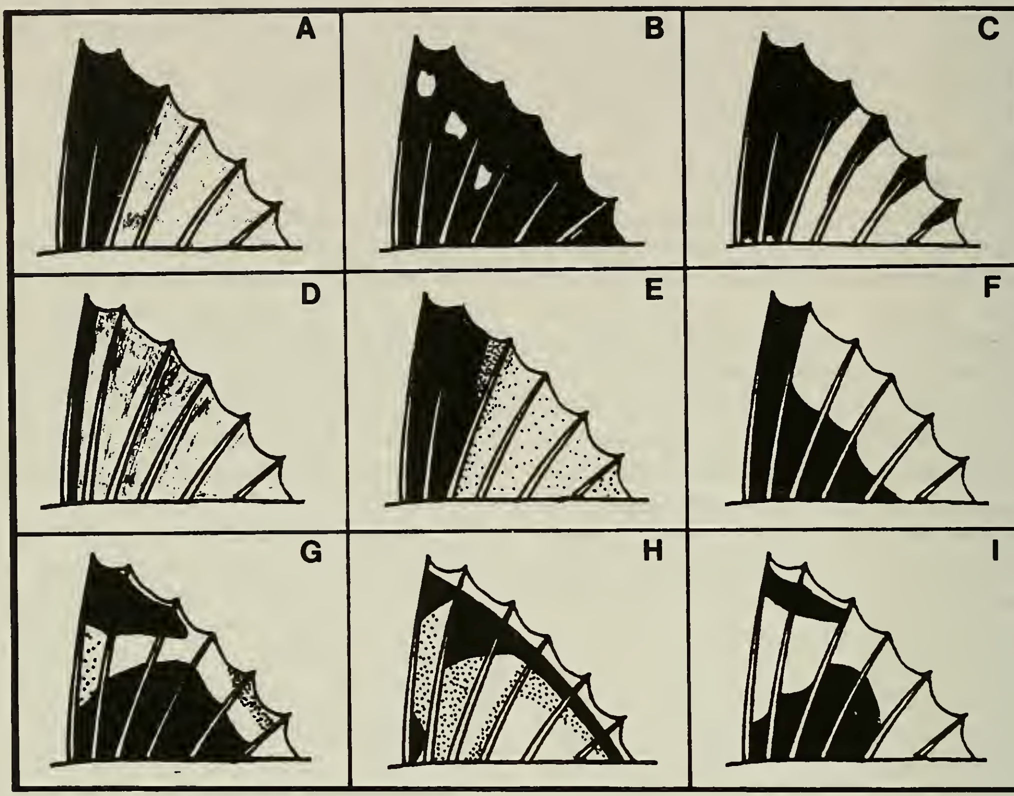

Fig. 1. Spinous dorsal fin pigment pattern in nine Atlantic *Bembrops:* A) *B. anatirostris*, B) *B. greyi*, C) *B. gobioides*, D) *B. heterurus*, E) *B. macromma*, F) *B. magnisquamis*, G) *B. ocellatus*, H) *B. quadrisella*, and I) *B. raneyi*.

The alimentary tract was dissected on 3–4 specimens of *B. anatirostris*, *B. gobioides*, *B. greyi*, *B. heterurus*, and *B. macromma* and pyloric caeca measured; length of caeca is given as percent of SL.

Collection depths were obtained from cruise reports and reported in meters (m). Maps in Williams (1968) were used for locating collecting sites of the two eastern Atlantic *Bembrops*.

Table 1.—Frequency distribution of the number of dorsal, anal, and pectoral rays in nine Atlantic species of *Bembrops*.

	Dorsal rays					Anal rays				Pectoral rays								
Species	14	15	16	17	18	16	17	18	19	22	23	24	25	26	27	28	29	30
B. anatirostris	8	105					20	92	1				3	16	59	31	4	
B. gobioides			9	163	6		4	163	9					30	111	33	1	1
B. greyi		10	48	2			26	34					4	44	12			
B. heterurus	6	67	2				1	69	5					25	50			
B. macromma	66						16	50	1			4	45	18				
B. magnisquamis		7	1				8			1	3	4						
B. ocellatus		8	28	2		1	7	29	2				4	23	11	1		
B. quadrisella		17	101	5		1	37	82	3				8	53	54	8		
B. raneyi		3	25	1			9	20					1	3	18	6	1	

Table 2.—Frequency distribution of the number of lateral-line scales in nine Atlantic species of *Bembrops*.

Species	Scales																										
	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
B. anatirostris															1	5	10	9	20	15	20	11	12	5	2	3	
B. gobioides																	5	4	26	22	32	35	13	20	10	8	1
B. greyi		1	—	5	15	11	17	8	4																		
B. heterurus											2	18	19	19	9	6	2										
B. macromma										8	10	13	10	9	5	3	2	1									
B. magnisquamis	4	1	2	1																							
B. ocellatus												1	1	1	5	5	7	6	7	4	1						
B. quadrisella														2	10	12	27	30	17	17	9	6					
B. raneyi													1	5	3	7	4	4	1								

Species accounts and distribution maps are based almost entirely on our own observations, not compilations of previous published information, so nearly all specimens used in this study have never been published upon. Exceptions are a few specimens from the National Museum of Natural History (USNM) and University of Florida (UF) cited in Das & Nelson (1996). Several Pacific *Bembrops* were examined for comparison to the nine Atlantic species: *B. curvatura* CAS 32808, 32976, 33100, 34393, 34589, and 88698 (25); *B. filifera* CAS 89509 (8); *B. nematopterus* USNM 347251 (1); *B. platyrhynchus* CAS 88685, USNM 345189 (5); *B.* sp. nov. CAS 88680, USNM 345190 (7). We recommend the use of "duckbill" for the common name of members of the genus *Bembrops* to avoid confusion with the commonly used name "flathead" as applied to the family Platycephalidae (Eschmeyer 1990). We suggest common names for the nine Atlantic species.

Genus *Bembrops* Steindachner, 1876

We examined the cephalic sensory pore system in detail in *Bembrops anatirostris*, *B. ocellatus*, and *B. raneyi* and found the general configuration of the canals to be nearly identical. We found that canals and pores were more discernible on those specimens that had lost patches of scales and pigmented skin from the head. Figure 2A is a composite sketch representing several specimens.

The most anterior pore is on either side near anterior tip of snout and the canals extending posteriorly from these two pores gradually converge toward the anterior portion of interorbital area. These two canals (left and right) pass medial to the anterior and posterior nares, respectively, and the second set of pores project laterally at this place and may easily be confused with the narial openings. The third set of pores is in a staggered arrangement, with respect to each other, at the anterior interorbital area

Table 3.—Frequency distribution of the number of gill rakers in nine Atlantic species of *Bembrops*.

	Upper limb				Lower limb							Total, both limbs								
Species	3	4	5	6	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
B. anatirostris		12	97	4			22	82	9						4	25	73	10	1	
B. gobioides		22	151	3		1	49	107	18	1				1	5	57	95	16	2	
B. greyi	6	49	5		4	17	39					1	6	14	36	3				
B. heterurus		18	57			2	25	45	3					1	10	24	37	2		
B. macromma		2	54	3	4	2	17	36					1	4	1	16	35	2		
B. magnisquamis		1	7			2	1	2	3						2	1	3	2		
B. ocellatus		1	33	1			12	18	5						1	11	18	4	1	
B. quadrisella			106				18	41	27	19	1					18	41	27	19	1
B. raneyi		2	24	3		6	18	5						2	4	15	8			

where the two canals (left and right) are separate but adjacent to each other. Between the anterior and posterior interorbital areas the two canals seem to join to form a single canal and at the posterior interorbital area there is a centrally located single pore. We do not know that this arrangement is typical, however an air jet placed at the single pore forced liquid out of both pores at the anterior interorbital area and the pores near the narial openings.

Immediately posterior to the single, interorbital pore the canal divides into a left and right branch and respectively circles around posterior rim of orbit. About half way around the posterior rim of orbit there is a branch canal that courses posteriorly and at the occipital area a short side branch projects medially, but right and left side branches do not join across the occiput. After the small side branch, the main (branch) canal continues to extend posteriorly and connects with the anterior end of each lateral-line canal. The two systems meet or join under the tip of a diagonally directed spine (posttemporal of some authors) and the anterior keeled lateral-line scale. The number of pores in the infraorbital canal posterior to the orbit varies in several species, having either 3 or 4 pores.

Table 4.—Frequency distribution of the number of vertebrae in nine Atlantic species of *Bembrops*.

Species	27	28	29	30	N	$\bar{X}$	*SD*
B. anatirostris	1	41			42	27.98	0.15
B. gobioides			2	35	37	29.95	0.23
B. greyi			8	46	54	29.85	0.36
B. heterurus		49	1		50	28.02	0.14
B. macromma	3	59			62	27.95	0.22
B. magnisquamis			8		8	29.00	—
B. ocellatus			2	12	14	29.87	0.34
B. quadrisella			6	31	37	29.83	0.37
B. raneyi			4	25	29	29.86	0.35

There is also a mucous canal and pore system associated with the preoperculomandibular area. This system is not connected with the cephalic system described above. The preoperculomandibular system extends from upper end of preopercle, ventrally and then anteriorly to anterior tip of lower jaw. The number of pores seem to be variable. Figure 2B illustrates the right preoperculomandibular canal of a *B. ocellatus* with nine pores. Thus we find the cephalic lateral-line system of *Bembrops* is somewhat abbreviated in comparison to that of the genus *Acanthaphritis*, subfamily Hemerocoetinae (Suzuki & Nakabo 1996) with *Bembrops* having the infraorbital canal very short, extending less than halfway to the anterior margin of the orbit and the preoperculomandibular branch not connecting with the lateral-line canal (Fig. 2A, B).

The cephalic canal system that passes through the posttemporal bone (ptt) and along the top of the supracleithrum (scl) in connecting with the lateral-line varies among the five Atlantic species examined. The size of each bone, expressed as percent of SL, and the degree to which the canal is

Table 5.—Proportional measurements (expressed in thousandths of standard length) for four western north Atlantic species of *Bembrops.*

Proportion	*B. anatirostris* $n = 50$			*B. gobioides* $n = 50$			*B. macromma* $n = 45$			*B. magnisquamis* $n = 6$		
	Range	$\bar{X}$	*SD*	Range	$\bar{X}$	*SD*	Range	$\bar{X}$	*SD*	Range	$\bar{X}$	*SD*
SL mm	65.8–246.0	157.7	46.18	84.6–217.4	162.3	33.53	77.3–190.0	117.9	23.15	72.0–104.2	91.8	12.33
Body depth	108–171	126	12.00	94–144	112	9.39	105–155	131	10.56	97–113	105	5.53
Caudal peduncle depth	48–59	53	2.59	45–53	48	2.33	52–64	59	2.78	55–60	57	2.17
Head length	329–426	382	16.86	325–371	346	10.98	331–424	385	12.34	359–386	376	10.40
Head depth	97–139	111	8.49	93–122	100	6.00	113–134	124	5.42	97–103	99	2.45
Head width	133–172	149	8.11	119–147	133	7.09	150–184	166	7.94	147–156	151	3.54
Interorbital width	6–10	9	1.16	6–11	8	1.13	7–13	10	1.28	8–10	9	0.82
Snout length	109–139	119	6.75	90–122	105	6.64	95–110	103	3.73	96–102	99	2.48
Orbit length	76–105	87	5.50	83–108	90	4.37	93–129	111	10.01	98–110	103	5.35
Upper jaw length	136–168	148	7.43	125–149	135	7.27	132–164	150	7.40	131–148	139	5.61
Lower jaw length	155–187	168	8.41	139–161	149	5.62	145–179	164	8.43	150–160	155	3.56
Postorbital length	158–197	174	9.40	136–160	150	5.45	161–189	170	15.55	164–184	175	6.76

enclosed by bone differs as follows: *B. anatirostris*—canal partly enclosed, longest ptt and scl, 6.5% and 5.7% (Fig. 3A); *B. gobioides*—canal an open groove, shortest ptt and scl, 5.3% and 4.2% (Fig. 3B); *B. greyi*, *B. heterurus*, and *B. macromma* are very similar with canal more or less completely enclosed with a single pore along length, intermediate-sized ptt and scl, 6.8% and 5.3%, 6.4% and 5.2%, 6.5% and 5.5%, respectively (Fig. 3C–E). There is a single large, exposed spine projecting posteriorly from the rear of the posttemporal just dorsal of the cephalic canal.

Bembrops anatirostris Ginsburg, 1955
Longnose duckbill

Dorsal fin in 113 specimens has VI, 14 or 15 soft rays, nearly all with 15 rays. Anal fin has 17 or 18 rays with a strong mode of 18. Pectoral fin rays range from 25 to 29 with the mode at 27 (Table 1).

Lateral-line scales range from 58 to 69, $\bar{X} = 63.3$ (Table 2). Gill rakers range from 4 to 6 on upper limb, 14 to 16 on lower limb and total counts range from 18 to 22 (Table 3). Number of vertebrae is almost always 28, only a single count of 27 (Table 4).

Bembrops anatirostris has the longest snout of the nine Atlantic species, with all specimens examined having the snout length greater than the orbit length (Tables 5, 9). *Bembrops anatirostris* has a long thin triangular maxillary tentacle, attenuate at tip. It has the longest tentacle of the nine species considered in this study (Table 10). Richards (1990) shows a rudimentary tentacle on a 9.4 mm SL *B. anatirostris* and a well-formed tentacle on a 15 mm SL (although there is a possibility these figures may be *B. raneyi*, also known from the Straits of Florida).

Bembrops anatirostris is the only one of the nine species in this study that has any prolonged dorsal spines; the second dorsal spine is prolonged in large males. We cannot confirm Das & Nelson's (1996) report-

Table 6.—Proportional measurements (expressed in thousandths of standard length) for two eastern Atlantic species of *Bembrops.*

	B. greyi $n = 62$			*B. heterurus* $n = 50$		
Proportion	Range	$\bar{X}$	*SD*	Range	$\bar{X}$	*SD*
SL mm	54.9–223.4	125.6	42.27	80.7–214.5	145.8	35.03
Body depth	96–156	118	13.14	121–167	137	11.07
Caudal peduncle depth	48–63	55	3.32	51–66	57	3.17
Head length	366–428	388	13.59	351–398	377	10.07
Head depth	96–137	114	8.60	109–156	124	9.78
Head width	138–172	153	7.36	133–191	162	12.82
Interorbital width	5–10	7	1.18	7–12	10	1.18
Snout length	82–122	105	10.35	106–124	114	4.05
Orbit length	100–125	112	6.75	74–103	93	5.88
Upper jaw length	138–175	155	10.86	140–160	152	5.47
Lower jaw length	152–191	171	10.79	158–187	173	6.85
Postorbital length	156–190	174	8.20	148–178	167	5.69

ing elongation of the third spine of first dorsal of this species since all males examined in this study had only the second spine elongated. There is a moderate correlation between length of specimen and length of spine. Twenty-one males that range from 147 to 230 mm in standard length have second dorsal spines (expressed in thousandths of standard length) that range from 172 to 381, $\bar{X} = 265$. The elongate spine possesses a narrow "flag" of black epidermis along the posterior margin from the margin of the fin to the tip of the spine.

The first two membranes of the spinous dorsal fin of *B. anatirostris* are a dull black, the remaining membranes are typically clear (Fig. 1A). Small specimens have an upper basal caudal spot but neither adult males nor females retain a distinct caudal spot.

Bembrops anatirostris has three long pyloric caeca, 12.5, 13.2, and 14.1 (left to right) % of SL. The caeca extend past the posterior end of the undistended stomach.

Distribution/Depth.—Northern Gulf of Mexico; Gulf of Campeche; also from northwestern edge of Little Bahamas Bank, western Caribbean Sea off Rosalind Bank and southern Nicaragua; southwestern Caribbean Sea off Panama; western end of Puerto Rico and Atlantic Ocean east of Dominica. Off South America—Colombia, eastern Venezuela, Guyana, and Suriname (Fig. 4). Additional records in Ginsburg (1955), Grey (1959), Uyeno et al. (1983), Boschung (1992), and Das & Nelson (1996). *Bembrops anatirostris* is the shallowest occurring species of the genus in the Atlantic. The depth range of our *B. anatirostris* is 82–549 m, with most specimens from 320 m or less. Ginsburg (1955) reported the species from 110–366 m, while Grey (1959) listed her material from 139–366 m, with most specimens from 220 m or less. Bullis & Struhsaker (1970) reported the highest density of *B. anatirostris* from 185–274 m, with few specimens from deeper waters. Das & Nelson (1996) listed the species from 100 to over 350 m. We examined one collection of *B. anatirostris* taken with *B. magnisquamis* off Costa Rica and one collection taken with *B. quadrisella* off Venezuela.

Material examined.—TU 26887 (1): Oregon 156; 27°22′N, 96°08′W; 180 m; 27 Nov 1950. TU 2732 (10): Oregon 278; 29°49′N, 85°45′W; 205 m; 24 Feb 1950. TU 10689 (7): Anna Inez 644; 28°52′N, 88°59′W; no depth recorded; 7 Jul 1955 [pyloric caeca dissection]. TU 10995 (4): Oregon 1094; 27°10′N, 96°20′W; 274 m; 5 Jun 1954. TU 12891 (4): Oregon 1095; 27°10′N, 96°17′W; 320 m; 5 Jun 1954. TU 12896 (2): Oregon 1093; 27°03′N,

Table 7.—Proportional measurements (expressed in thousandths of standard length) for three new species of *Bembrops*.

Proportion	*B. ocellatus* n = 14				*B. quadrisella* n = 16				*B. raneyi* n = 19			
	Holotype	Range	$\bar{x}$	*SD*	Holotype	Range	$\bar{x}$	*SD*	Holotype	Range	$\bar{x}$	*SD*
SL mm	135.3	90.9–190.0	128.5	23.89	195.0	127.5–235.3	182.6	30.39	136.0	69.1–167.3	124.2	26.79
Body depth	120	91–121	106	9.19	107	96–128	112	9.20	98	97–136	110	10.58
Caudal peduncle depth	51	44–58	50	3.72	48	47–55	50	2.22	47	45–55	50	3.09
Head length	363	349–387	369	10.93	373	340–404	376	15.46	370	348–390	369	11.49
Head depth	117	92–117	104	6.42	105	96–127	108	7.97	98	89–116	102	6.33
Head width	155	139–157	147	4.92	145	134–165	150	9.45	152	139–178	152	8.96
Interorbital width	7	5–10	7	1.40	8	5–9	8	1.31	9	6–11	8	1.26
Snout length	107	99–116	103	4.72	105	105–126	113	4.98	104	90–116	101	6.75
Orbit length	98	92–113	103	7.23	103	92–120	103	8.70	112	88–116	105	7.94
Upper jaw length	138	136–158	145	7.13	150	139–160	151	6.56	144	133–149	141	3.87
Lower jaw length	149	147–170	156	7.74	161	154–175	164	7.43	157	142–161	152	5.82
Postorbital length	159	155–172	164	4.80	164	150–218	168	14.35	163	156–178	166	5.99

96°16′W; 384 m; 4 Jun 1954. TU 12962 (1): Oregon 895; 28°47′N, 85°19′W; 117 m; 7 Mar 1953. TU 12981 (2): Oregon 864; 29°19′N, 86°04′W; 150 m; 31 Oct 1953. TU 17609 (3): Oregon 2000; 07°55′N, 57°30′W; 82 m; 5 Nov 1957. TU 90207 (1): Oregon-II 13167; 29°15.7′N, 88°09′W; 128 m; 3 May 1973. TU 90224 (1): 29°14.7′N, 88°08.5′W; 165 m; 3 May 1973. TU 90241 (8): Oregon-II 13170; 29°14′N, 88°09.3′W; 183 m; 3 May 1973. TU 180139 (7): Oregon 1985; 09°41′N, 59°47′W; 274 m; 3 Nov 1957. TU 180140 (5): Oregon 2012; 07°34′N, 54°19′W; 274 m; 8 Nov 1957. TU 180141 (4): Oregon 2203; 29°13.5′N, 88°12′W; 229 m; 26 Jun 1958. TU 180142 (1): Silver Bay 441; 27°39′N, 79°15′W; 503–549 m; 9 Jun 1958. TU 180337 (3): Oregon 1984; 09°45′N, 59°45′W; 366 m; 3 Nov 1957. TU 180338 (8): Oregon 1989; 09°45′N, 59°45′W; 366 m; 4 Nov 1957. TU 180339 (10): Oregon 2005; 07°37′N, 54°50′W; 366 m; 6 Nov 1957. TU 180340 (1): Oregon 2023; 07°15′N, 53°21′W; 247 m; 9 Nov 1957. TU 180341 (1): Silver Bay 175; 28°05′N, 90°52′W; 183 m; 20 Sep 1957. TU 180342 (5): Oregon 2022; 07°15′N, 53°25′W; 210 m; 9 Nov 1957. TU 180343 (8): Oregon 1983; 09°53′N, 59°53′W; 229 m; 3 Nov 1957. TU 180344 (2): Oregon 1981; 10°03′N, 60°01′W; 366 m; 3 Nov 1957. TU 180345 (2): Silver Bay 154; 28°58′N, 84°44′W; 139–148 m; 22 Aug 1957. TU 180346 (1): Oregon 1884; 16°53′N, 81°22′W; 411 m; 23 Aug 1957. TU 180347 (1): Silver Bay 100; 29°10′N, 85°48′W; 101–130 m; 26 Jul 1957. TU 180348 (1): Oregon 1986; 09°39′N, 59°47′W; 183 m; 4 Nov 1957. USNM 304921 (2): Oregon 4838; 11°09′N, 74°24′W; 329 m; 16 May 1965. USNM 343811 (2): Oregon 2658; 18°26′N, 67°11.5′W; 320 m; 7 Oct 1959. Examined for distribution information (Fig. 4): USNM 231943 (2), 278482 (4), 308117 (4), 347203 (6), 347222 (1), 347274 (1), 347275 (2), 347276 (2), 347277 (3), 347278 (1), 347279 (2), 347280 (5),

Table 8.—Frequency distribution of head width divided by head depth in nine Atlantic species of *Bembrops.*

Species	Standard length in mm	*n*	Ratio						
			1.1	1.2	1.3	1.4	1.5	1.6	1.7
B. anatirostris	65.8–246.0	50		9	20	18	3		
B. gobioides	84.6–217.4	50		6	25	15	4		
B. greyi	54.9–223.4	62	1	7	32	17	3	2	
B. heterurus	80.7–214.5	50	1	9	27	12	1		
B. macromma	77.3–190.0	45		2	29	14			
B. magnisquamis	72.0–104.2	6		1	—	1	3	1	
B. ocellatus	90.9–190.0	14			1	9	3	1	
B. quadrisella	127.5–235.3	16		1	4	7	4		
B. raneyi	69.1–167.3	19				4	11	3	1

347281 (4), 347282 (4), 347283 (3), 347284 (2), 347285 (8), 347286 (1).

Bembrops gobioides (Goode, 1880)
Goby duckbill

Dorsal fin in 178 specimens has VI, 16–18 soft rays, with a strong mode of 17 rays. Anal fin rays vary in number from 17 to 19, mostly 18. Pectoral fin rays range from 26 to 30, with a strong mode of 27 (Table 1). Lateral-line scales range from 60 to 70, $\bar{X}$ = 64.6 (Table 2). Gill rakers range from 4 to 6 on upper limb, 13 to 17 on lower limb, and total counts range from 17 to 22, usually 19 or 20 (Table 3). Number of vertebrae is almost always 30 (35 of 37), two counts of 29 (Table 4).

Based on 50 specimens ranging from 84.6 to 217.4 mm in SL, five have the orbit length equal to the length of snout but most specimens have the snout longer than the eye (Tables 5, 9). An additional small specimen (84 mm SL) not included in Tables 5 and 9 has the orbit slightly greater in length than length of snout. This observation matches that presented by Ginsburg (1955, Table 4) for an 81 mm SL specimen.

Bembrops gobioides typically has 17 soft dorsal rays, 18 anal rays, 27 or 28 pectoral rays, more than 60 lateral-line scales, and 30 vertebrae all among the highest values for these characters for the nine Atlantic species. Its 30 vertebrae contrasts with *B. anatirostris* which typically has 28 vertebrae. The caudal peduncle of *B. gobioides* is less deep than that in *B. anatirostris.* There is a more pronounced change in relative size of orbit and snout with respect to size of specimen than was observed for *B. anatirostris.* No small specimens of *B. anatirostris* has the orbit exceeding or equal to length of snout, whereas *B. gobioides* specimens between 80 to 85 mm in SL have the orbit equal to or greater than length of

Table 9.—Frequency distribution of snout length divided by orbit length in nine Atlantic species of *Bembrops.*

Species	Standard length in mm	*n*	Ratio									
			0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
B. anatirostris	65.8–246.0	50					2	5	14	18	10	1
B. gobioides	84.6–217.4	50				5	17	21	7			
B. greyi	54.9–223.4	62	5	11	15	19	12					
B. heterurus	80.7–214.5	50					10	24	11	4	1	
B. macromma	77.3–190.0	45	1	10	12	18	4					
B. magnisquamis	72.0–104.2	6			3	3						
B. ocellatus	90.9–190.0	33			11	14	6					
B. quadrisella	127.5–235.3	94			6	50	18	17	3			
B. raneyi	69.1–167.3	19		3	8	3	4	1				

Table 10.—Maxillary tentacle length (expressed in thousandths of standard length) in nine Atlantic species of *Bembrops.*

Species	*n*	Range	$\bar{X}$	*SD*
B. anatirostris	53	33–71	51	9.42
B. gobioides	48	20–37	28	4.20
B. greyi	121	15–51	33	7.78
B. heterurus	98	12–50	30	8.83
B. macromma	87	7-27	18	4.60
B. magnisquamis	12	17–49	37	9.70
B. ocellatus	27	19–39	26	5.33
B. quadrisella	30	14–27	21	3.50
B. raneyi	38	31–59	41	7.47

snout. The maxillary tentacle of *B. gobioides* is small to moderate in length and is triangular in shape, whereas *B. anatirostris* has a very long tentacle that has an attenuate distal portion.

The spinous dorsal fin pigmentation of *B. gobioides* is similar in some respects to that described for *B. anatirostris*; the first two membranes are blackened, however there are additional wedges of black pigmentation at the distal ends of spines 3–6 (Fig. 1C).

Bembrops gobiodes has three short pyloric caeca, 6.0, 5.4, and 6.2 (left to right) % of SL.

Distribution/Depth.—Northwestern, northcentral and northeastern Gulf of Mexico; Dry Tortugas; southern Gulf of Mexico, north of Yucatan; off east coast of Florida; western Little Bahamas Bank; no records from Caribbean Sea (Fig. 5). Additional records in Ginsburg (1955), Grey (1959), Boschung (1992), and Das & Nelson (1996). The depth range of our *Bembrops gobiodes* is 329–549 m, with most specimens taken between 350 to 450 m. Ginsburg (1955) listed this species from 119–512 m and Grey (1959) reported it between 338 and 438 m. Das & Nelson (1996) reported it from about 100 to over 700 m. Bullis & Struhsaker (1970) reported the highest densities of *B. gobiodes* from the western Caribbean in two depth ranges, 276–366 m and 459–549 m, but these probably represent a composite of two of our new species since we have no valid records of this species from the Caribbean Sea.

Material examined.–TU 1709 (6): Oregon 61; 29°04′N, 88°30′W; 357 m; 2 Aug 1950. TU 2692 (1): Oregon 62; 29°01′N, 88°30′; 424 m; 2 Aug 1950. TU 2729 (4): Oregon 162; 27°18′N, 96°09′W; 366 m; 28 Nov 1950. TU 2730 (5): Oregon 163; 27°15′N, 96°00′W; 430 m; 28 Nov 1950. TU 11714 (8): Oregon 1520-80; 29°10′N, 88°10′W; 366–457 m; 16–19 May 1956. TU 12869 (4): Oregon 1107; 29°03′N, 88°25′W; 384–430 m; 15 Jun 1954. TU 12897 (5): Oregon 1093; 27°03′N, 96°16′W; 384 m; 4 Jun 1954. TU 12943 (13): Oregon 1091; 26°41′N, 96°20′W; 366–384 m; 3 Jun 1954. TU 14779 (2): Pelican 60; 28°29′N, 79°54′W; 293–347 m; 11 Jun 1956. TU 14810 (1): Pelican 66; 28°33′N, 79°52′W; 357–371 m; 13 Jun 1956. TU 17073 (25): Combat 332; 28°55′N, 79°56′W; 329 m; 31 May 1957 [pyloric caeca dissection]. TU 35788 (3): Oregon 4367; 24°31′N, 83°30′W; 375 m; 5 Aug 1963. TU 35802 (3): Oregon 4367; 24°31′N, 83°30′W; 375 m; 5 Aug 1963. TU 35803 (5): Oregon 4368; 24°31′N, 83°30′W; 375 m; 5 Aug 1963. TU 35805 (5): Oregon 4368; 24°28′N, 83°26′W; 384 m; 5 Aug 1963. TU 35832 (3): Oregon 4371; 24°28′N, 83°27′W; 375 m; 6 Aug 1963. TU 35863 (2): Oregon 4372; 24°29′N, 83°32′W; 375 m; 6 Aug 1963. TU 90280 (1): Oregon-II 13208; 29°16.1′N, 87°38.4′W; 457 m; 4 May 1973. TU 90300 (2): Oregon-II 13210; 29°15.6′N, 87°45.0′W; 411 m; 4 May 1973. TU 90320 (1): Oregon-II 13218; 29°14.5′N, 87°44′W; 494 m; 5 May 1973. TU 90342 (6): Oregon-II 13222; 29°10.4′N, 88°07.9′W; 366 m; 5 May 1973. TU 90398 (7): Oregon-II 13254; 28°54.7′N, 88°45.6′W; 347 m; 7 May 1973. TU 90406 (18): Oregon-II 13256; 29°00′N, 88°35.5′W; 347 m; 7 May 1973. TU 90425 (10): Oregon-II 13260; 28°55.2′N, 88°40′W; 411 m; 7 May 1973. TU 90468 (5): Oregon-II 13332; 24°23.4′N, 83°24.1′W; 402 m; 21 May 1973. TU 90485 (17): Oregon-II 13338; 24°20.1′N,

Table 11.—Summary of fin pigment patterns for nine Atlantic species of *Bembrops*.

Fin/species	Spinous dorsal	Second dorsal	Anal	Caudal	Pectoral	Pelvic
anatirostris	memb 1 & 2 dark grey; other memb light grey to clear; with black filament on spine 2	distal ½ of fin dark; basal ½ clear; pigment on entire length of rays	distal ½–⅔ of fin black; males with dusky base, females with base clear	uniform grey wash over entire fin	pigment along rays, most at base of center rays; blotch at dorsal base of rays 2–3	slight duskiness on post ½ of fin
greyi	♀: memb black, several clear spots memb 1–3; ♂: black at base & top of fin, clear center	2 dark bands, one distal, one basal, along entire fin	♀: clear fin; ♂: dusky or clear fin	♀: strong ocellus at dorsal fin base; ♂: lacks ocellus, some diffuse pigment at base; 2 dark bands & mottling at posterior ½	dark pigment along rays; fin with dark crescent at fin base on medial side of fin	post ½ dusky, ant ½ clear
gobioides	memb 1 & 2 dark; distal margins of other memb black; some with black at base of memb 2–4	2 dark bands; distal one along entire fin, basal band widely interrupted by clear areas	usually clear; some ♂♂ with slight duskiness	ventral and post margins black; ♀ with ocellus or dark blotch, ♂ lack ocellus	melanophores on rays, mostly on ventral ⅓ of fin; dark crescent at fin base	slight duskiness on post ½ of fin
heterurus	ant ½ of memb 1 dark; rest of fin with grey wash	clear to light brown-grey wash; no distinct pattern	single black band on distal ½ of entire fin length	slight grey-brown wash; no distinct pattern	melanophores along rays, darker at base of center rays	some with duskiness on post ½ of fin
macromma	memb 1 & 2 (sometimes part of 3) black; rest of fin clear or slightly dusky	distal fifth of fin with black band	♀: very thin black band or clear fin; ♂: black band on distal ¼ of fin	post ¼–⅓ black	slight scattering of melanophores on rays	small melanophores on rays and memb at edge of rays
magnisquamis	basal black blotch memb 2–4; memb 1 all black	basal black along length of fin; slight distal black band	slight black at distal margin; most of fin clear	dusky across fin; 2 distinct black spots	pigment on rays concentrated at base on both sides of fin	pigment on membranes and edge of rays 3–5
ocellatus	basal black blotch in memb 1–5; submarginal black blotch in memb 1–3; melanophores in memb 1, 4, 5	most of fin clear; black at base of rays 1–5 & 9–13 (at saddles); black on distal ¼ of rays	usually clear; few melanophores in some specimens; post rays with slight basal pigment	♀: large ocellus in dorsal fin base; ♂: wedge of black in same location; dorsal, post and ventral margin black	melanophores on rays	small melanophores on rays in post ½ of fin

Table 11.—Continued.

Fin/species	Spinous dorsal	Second dorsal	Anal	Caudal	Pectoral	Pelvic
quadrisella	small basal black blotch in memb 1; submarginal black in all memb with triangular extension in memb 1 & 2; some scattered melanophores in memb	dusky membranes; some black at base of ant memb; white bands in fin	♀: light grey or clear; about distal ½–⅔ of fin black; white pigment on memb	♀: ocellus at dorsal fin base; ♂: no ocellus; post and ventral margins dark	melanophores on rays; white pigment at base of lower rays	post ½ dusky; outer memb darker; white pigment on both surface of fin memb at base of fin
raneyi	submarginal black band in memb 1 & 2; large basal black blotch in membs 2–4, covering ½ of memb 3 & 4	black at base of rays 1–5 & 10–12; distal black band	clear in both sexes	black blotch, often as an ocellus at base of fin extending onto body; ventral and post margins black; post ½ of dorsal margin black; dusky at center of fin	melanophores on rays except ventral 4–5 rays that are clear	few light, scattered melanophores

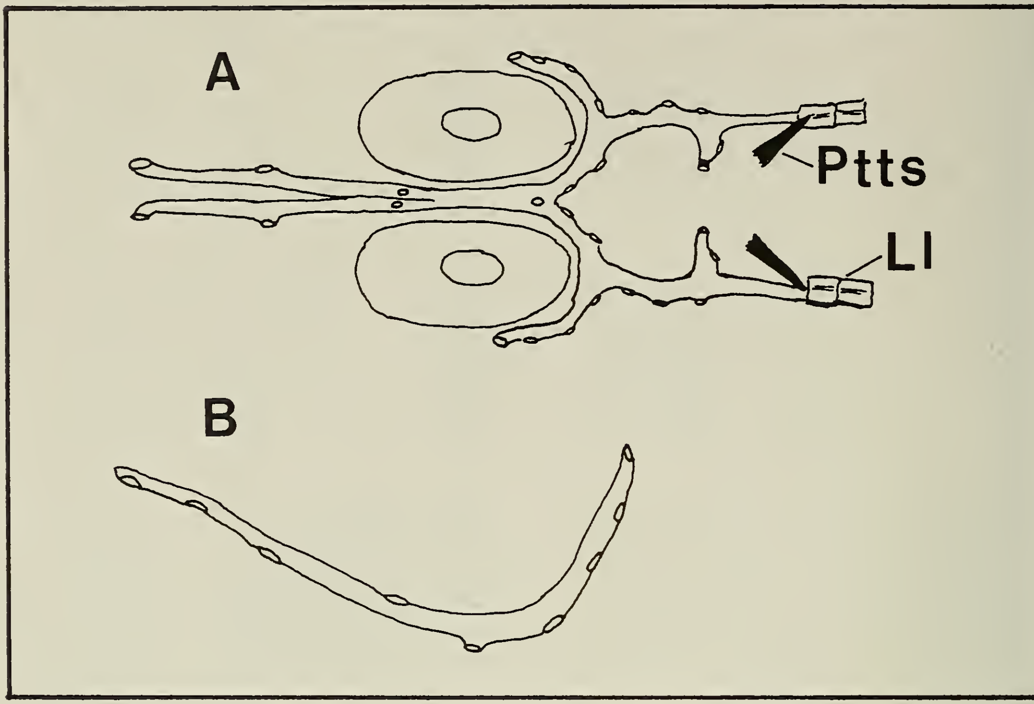

Fig. 2. Cephalic sensory pore system: A. Composite of *Bembrops anatirostris*, *B. ocellatus*, and *B. raneyi*. B. Right preoperculomandibular canal of *B. ocellatus*. Ptts = posttemporal spine, L1 = lateral-line.

83°09.9′W; 402 m; 22 May 1973. TU 90503 (13): Oregon-II 13344; 24°16′N, 82°52.7′W; 402 m; 22 May 1973. TU 90565 (1): Oregon-II 13362; 24°09′N, 82°31′W; 549 m; 23 May 1973. TU 180143 (1): Silver Bay 221; 29°21′N, 80°06′W; 329–347 m; 22 Nov 1957. TU 180144 (1): Silver Bay 212; 29°59′N, 80°07′W; 366 m; 20 Nov 1957. TU 180145 (1): Silver Bay 224; 29°29′N, 80°09′W; 329 m; 24 Nov 1957. TU 180146 (1): Silver Bay 217; 29°41′N, 80°08′W; 329–366 m; 21 Nov 1957. TU 180147 (2): Combat 464; 27°51′N, 79°50′W; 393 m; 29 Jul 1957. TU 180148 (1): Combat 482; 29°28′N, 80°08′W; 347 m; 17 Aug 1957. TU 180149 (5): Combat 317; 29°07′N, 80°04′W; 366 m; 27 Apr 1957. TU 180150 (6): Combat 462; 27°14′N, 79°50′W; 384 m; 29 Jul 1957. TU 180151 (3): Combat 330; 29°08′N, 80°03′W; 347 m; 31 May 1957. TU 180152 (4): Combat 314; 29°38′N, 80°11′W; 329 m; 27 Apr 1957. TU 180153 (5): Combat 467; 28°36′N, 79°54′W; 402 m; 30 Jul 1957. TU 180154 (2): Combat 479; 29°22′N, 80°06′W; 366 m; 17 Aug 1957. TU 180155 (1): Combat 316; 29°20′N, 80°04′W; 393 m; 27 Apr 1957. TU 180156 (3): Combat 463; 27°22′N, 78°50′W; 402 m; 29 Jul 1957. TU 180349 (1): Combat 501; 29°36′N, 80°07′W; 384 m; 12 Sep 1957.

Bembrops greyi Poll, 1959
Blackfin duckbill

Dorsal fin in 60 specimens has VI, 15 to 17 soft rays, with a strong mode of 16 rays. Anal fin has 17 or 18 rays, with a greater frequency of 18 rays. Pectoral fin rays range from 25 to 27 in number, with a mode of 26 (Table 1). Lateral-line scales range from 45 to 52, $\bar{X}$ = 49.2 (Table 2). Gill rakers range from 3 to 5 on upper limb, 12 to 14 on lower limb, and total counts range from 15 to 19, usually 17 or 18 (Table 3).

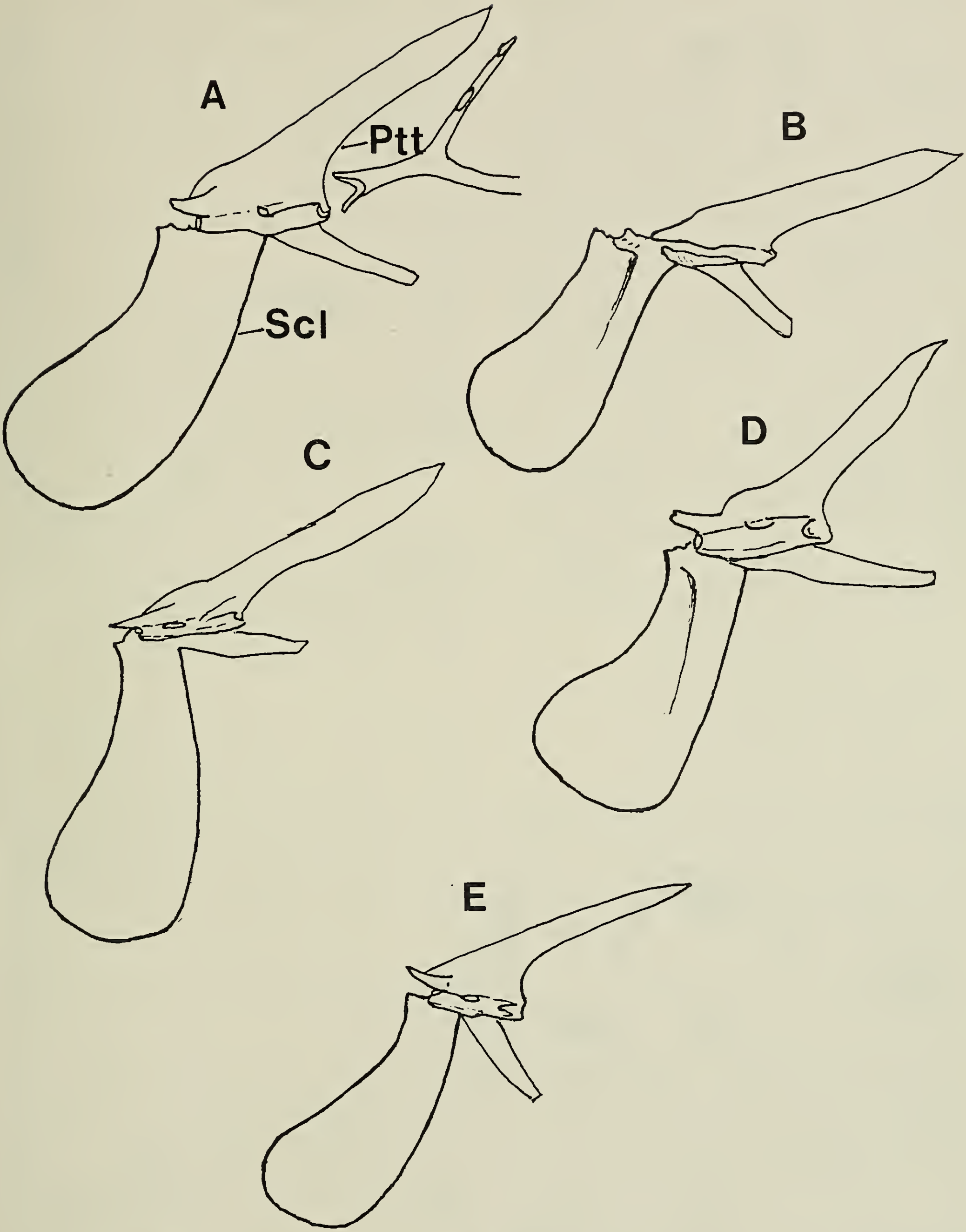

Fig. 3. Posttemporal and supracleithrum of five species of *Bembrops:* A) *B. anatirostris*, B) *B. gobioides*, C) *B. greyi*, D) *B. heterurus*, and E) *B. macromma.* Ptt = posttemporal, Scl = supracleithrum.

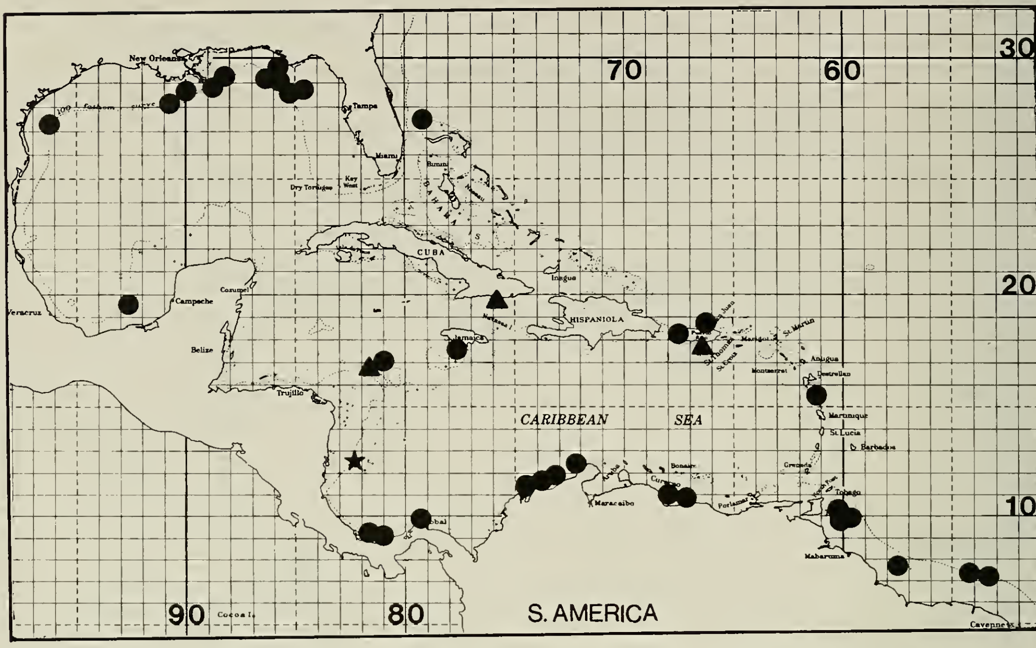

Fig. 4. Distribution of *Bembrops anatirostris* (●), *B. magnisquamis* (▲), and (★) both species.

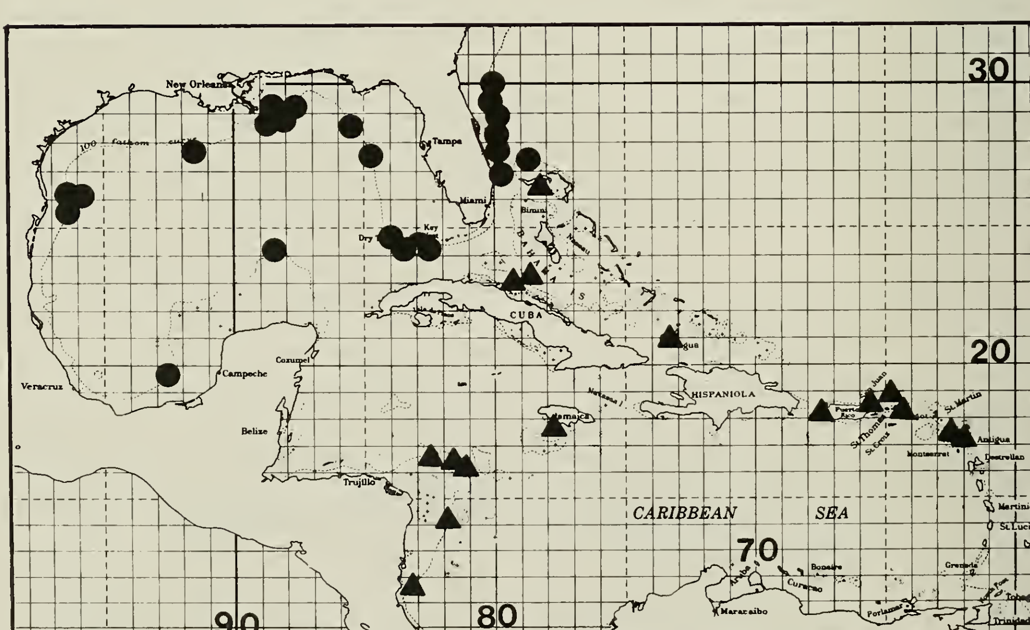

Fig. 5. Distribution of *Bembrops gobioides* (●), *B. macromma* (▲).

Number of vertebrae is typically 30, however eight have 29 (Table 4).

Based on 62 specimens ranging from 54.9 to 223.4 mm SL; half (31 specimens) have the orbit length greater than length of snout; the orbit and snout lengths are equal in 19 specimens; and in 12 specimens the snout length is greater than the orbit length (Table 9).

Based on 121 maxillary tentacle measurements (representing 62 specimens) the tentacle length in *B. greyi* is slightly greater than average among the nine species (Table 10), although *B. anatirostris*, *B. raneyi*, and *B. magnisquamis* have longer tentacles.

In summary, *Bembrops greyi* has a low number of lateral-line scales with only *B. magnisquamis* having as low a lateral-line scale count. *Bembrops greyi* has the lowest average number of gill rakers of the nine species and typically has a high number of vertebrae (30). *Bembrops greyi* has a short snout and a moderately long maxillary tentacle.

The spinous dorsal fin pigmentation in *Bembrops greyi* is unique, in that, except for several small, irregular-shaped clear windows, the entire fin is jet-black (Fig. 1B).

Bembrops greyi has three medium-length pyloric caeca, 6.8, 6.4, and 6.9 (left to right) % of SL.

Distribution/Depth.—Eastern Atlantic Ocean in Gulf of Guinea off Grand-Bassam, Cote D'Ivoire, off Lagos, Nigeria; and from equator near Port Gentil, Gabon southward to Pointe Noire, Congo. We examined three collections with *Bembrops greyi* taken with *B. heterurus* (Fig. 6). Additional records in Poll (1959) and Das & Nelson (1996). Our records of *Bembrops greyi* range from a depth of 101–494 m, with the largest series (19) containing many juveniles at the shallowest depth. Most collections are from 300–400 m. Poll (1959) reported it between 250–420 m, Blache et al. (1970) between 250–400 m, and Das & Nelson (1996) from 250–420 m.

Material examined.—CU 48206 (19): Geronimo 2-199; 01°26′S, 08°24′E; 400 m; 3 Sep 1963. CU 48215 (1): Geronimo 2-220; 03°02′S, 09°21′E; 300 m; 6 Sep 1963. CU 48216 (6): Geronimo 2-205; 01°57′S, 08°47′E; 400 m; 4 Sep 1963. CU 48217 (1): Geronimo 2-238; 04°07′S, 10°23′E; 400 m; 8 Sep 1963. CU 48218 (1): Geronimo 2-179; 00°02′S, 08°50′E; 295 m; 31 Aug 1963. CU 48219 (1): Geronimo 2-237; 04°03′S, 10°22′E; 300 m; 8 Sep 1963. CU 48220 (6): Geronimo 2-246; 04°31′S, 10°53′E; 300 m; 9 Sep 1963. CU 48221 (5): Geronimo 2-204; 01°56′S, 08°47′E; 300 m; 4 Sep 1963. UF 216947 (3): Pillsbury 51; 04°56′N, 05°01′W–04°56′N, 05°03′W; 329–494 m; 31 May 1964 [pyloric caeca dissection]. UF 220549 (19): Pillsbury 236; 05°20′N, 04°45′E–05°19′N, 04°48′E; 101–128 m; 12 May 1965.

Bembrops heterurus (Ribeiro, 1903)
Robust duckbill

Next to *Bembrops macromma*, *B. heterurus* has the lowest number of dorsal soft rays. The dorsal fin formula for *B. heterurus* is VI, 14 to 16 soft rays, with a strong model count of 15. Anal fin rays are usually 18, only six specimens deviate from this count. Pectoral fin ray counts are either 26 or 27, and 27 is the more frequent number (Table 1).

Bembrops heterurus has an intermediate number of lateral-line scales, between the high counts of *B. anatirostris* and *B. gobioides* and the low counts of *B. greyi* and *B. magnisquamis.* Lateral-line scales range from 55 to 60, $\bar{X}$ = 56.5, being most similar to *B. macromma* (Table 2) and overlapping the counts of the three new species.

Bembrops heterurus exceeds *B. greyi* in number of gill rakers; there are either four or five on upper limb, range from 13 to 16 on lower limb, and total counts range from 17 to 21 (Table 3). *Bembrops heterurus* and *B. greyi* differ markedly in number of vertebrae; *B. heterurus* typically has 28 where *B. greyi* typically has 30 vertebrae (Table 4).

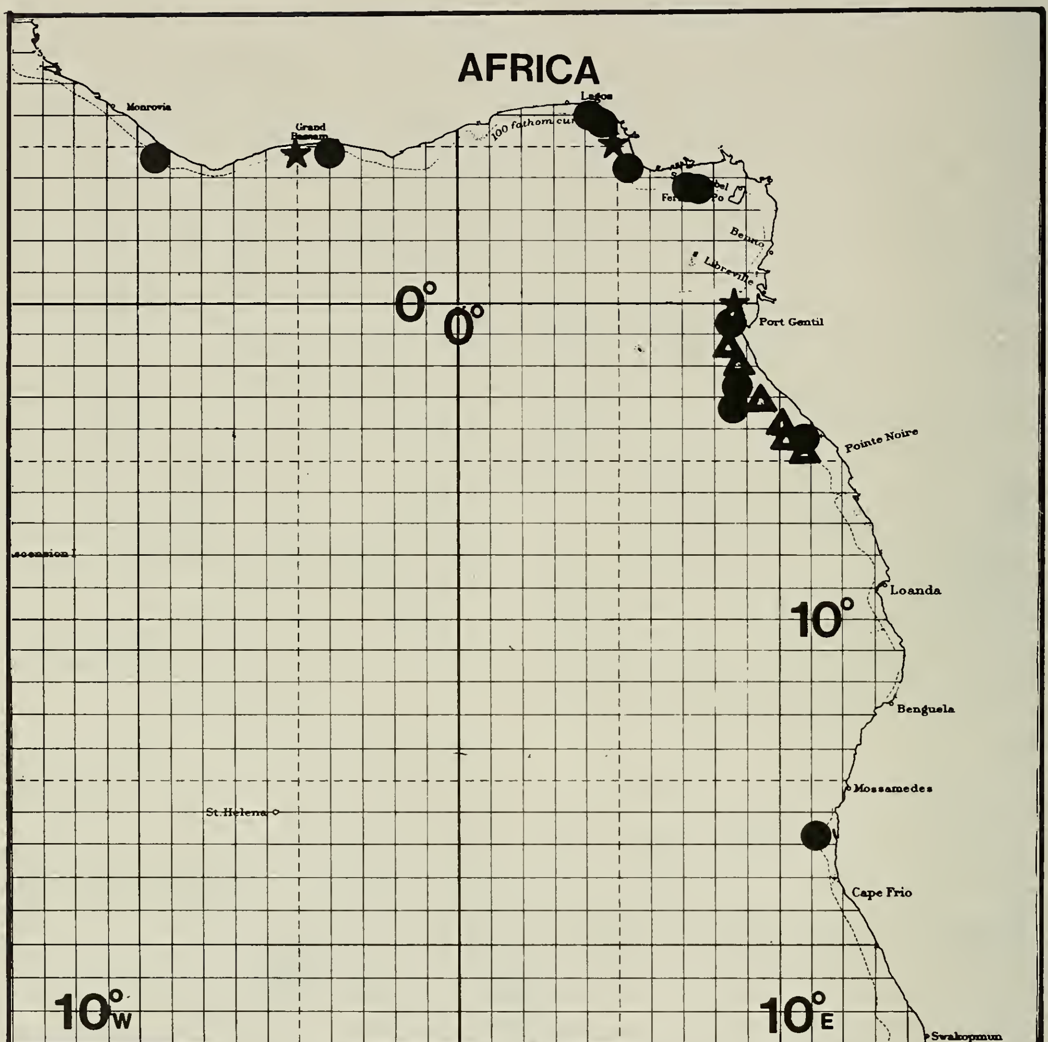

Fig. 6. Distribution of *Bembrops greyi* (△) and *B. heterurus* (●) based on specimens examined in this study. Three syntopic collections (★).

Based on 50 specimens ranging from 80.7 to 214.5 mm SL, all have a snout greater than the eye; with none having the orbit length greater than or equal to length of snout (Tables 6 and 9).

Maxillary tentacle lengths are quite similar in *B. heterurus* and *B. greyi* (Table 10), with *B. heterurus* having the third longest tentacle among the Atlantic species.

The spinous dorsal fin pigmentation in *Bembrops heterurus* contrasts greatly with that described for *B. greyi.* Only the anterior half of the first membrane is blackened in *B. heterurus,* with the rest of the fin clear or slightly dusky (Fig. 1D), whereas, except for small clear areas the entire fin is jet-black in *B. greyi.*

Bembrops heterurus has three moderately-long pyloric caeca, 9.7, 10.1, 9.6 (left to right) % of SL.

Distribution/Depth.—Eastern Atlantic Ocean in Gulf of Guinea off southeastern Liberia; off Cote D'Ivoire in Bight of Benin and Bight of Bonny near Fernando Poo;

southward along African coast from Port Gentil, Gabon to Pointe Noire, Congo; one record near Baia dos Tigres, southern Angola (Fig. 6). We examined three collections that had *Bembrops heterurus* taken with *B. greyi.* Bianchi et al. (1993) reported *Bembrops heterurus* as rare in Namibia its southernmost distribution along the west coast of Africa. Depth for *Bembrops heterurus* used in this study ranged from 64–494 m, with most records between 150 and 300 m. Poll (1959) reported this species between 100 and 300 m. Fager & Longhurst (1968) found *B. heterurus* to be part of a "species group" centered around 200 m depth. Blache et al. (1990) gave a range between 100–400 m. Das & Nelson (1996) reported a depth range for South American specimens of this species from 90–200 m.

Material examined.—CU 48207 (6): Geronimo 2-197; 01°30′S, 08°27′E; 200 m; 3 Sep 1963. CU 48208 (1): Geronimo 2-187; 00°32′S, 08°40′E; 300 m; 1 Sep 1963. CU 48209 (5): Geronimo 2-245; 04°31′S, 10°54′E; 200 m; 9 Sep 1963. CU 48210 (1): Geronimo 2-185; 00°32′S, 08°42′E; 200 m; 1 Sep 1963. CU 48211 (1): Geronimo 2-213; 02°31′S, 08°51′E; 300 m; 5 Sep 1963. CU 48212 (5): Geronimo 2-212; 02°30′S, 08°58′E; 200 m; 5 Sep 1963. CU 48213 (2): Geronimo 2-227; 03°30′S, 08°53′E; 200 m; 7 Sep 1963. CU 48214 (5): Geronimo 2-203; 02°01′S, 08°50′E; 200 m; 4 Sep 1963. TU 180287 (3): Undaunted 252; 16°41′S, 11°21′E; 164–182 m; 18 Mar 1968. UF 47051 (1): Geronimo 2-179; 00°02′S, 08°50′E; 295 m; 31 Aug 1963. UF 216954 (1): Pillsbury 51; 04°56′N, 05°01′W–04°56′30″N, 05°03′W; 329–494 m; 31 May 1964. UF 216958 (1): Pillsbury 82; 04°57′N, 09°30′W–04°58′N, 09°32′W; 146–150 m; 5 Jun 1964. UF 216974 (4): Pillsbury 45; 05°05′N, 04°04′30″W–05°06′N, 04°06′W; 73–97 m; 30 May 1964. UF 220545 (7): Pillsbury 255; 03°49′N, 07°38′E–03°48′N, 07°42′E; 264–269 m; 14 May 1965 [pyloric caeca dissection]. UF 220546 (8): Pillsbury 232; 05°56′N, 04°27′E–05°54′N, 04°27′E; 101–132 m; 11 May 1965. UF 220547 (5): Pillsbury 237; 05°19′N, 04°48′E–05°07′N, 04°55′E; 101 m; 12 May 1965. UF 220548 (2): Pillsbury 236; 05°20′N, 04°45′E–05°19′N, 04°48′E; 101–128 m; 12 May 1965. UF 220551 (7): Pillsbury 245; 04°32′N, 05°07′E–04°31′N, 05°13′E; 64–119 m; 13 May 1965. UF 220552 (11): Pillsbury 254; 03°50′N, 07°08′E–03°51′N, 07°12′E; 148–174 m; 14 May 1965.

Bembrops macromma Ginsburg, 1955
Scaled-eye duckbill

Dorsal fin rays in all specimens are VI, 14. *Bembrops macromma* is unique among the Atlantic species in its consistent low number of dorsal soft rays. The only other species with 14 soft dorsal rays are *B. anatirostris* and *B. heterurus* and this is rare. Anal fin rays are usually 18 in number, but frequently are 17. Pectoral fin rays are usually 25, but frequently 26, rarely 24 (Table 1).

Bembrops macromma is similar to *B. heterurus* in having an intermediate number of lateral-line scales, 53 to 60, $\bar{X} = 56.0$ (Table 2). Gill rakers range from 4 to 6, usually 5, on upper limb, range from 12 to 15, usually 14 or 15, on lower limb, and total counts range from 16 to 21, predominantly 19 or 20 (Table 3).

Bembrops macromma, like *B. anatirostris* and *B. heterurus* has a low number of vertebrae, usually 28, very rarely 27, the lowest vertebral number for Atlantic *Bembrops* (Table 4).

Both *Bembrops macromma* and *B. heterurus* have stocky bodies, illustrated by the greater depth of head, depth of body at origin of first dorsal fin, and depth of caudal peduncle. *Bembrops macromma* has a short snout and large orbit whereas *B. heterurus* has a relatively long snout and a small orbit (Table 9). *Bembrops macromma* also differs from *B. heterurus* in length of maxillary tentacle, having the shortest tentacle of the nine species treated in this study (Table 10).

Bembrops macromma is unique in the

genus in possessing scales on the dorsal surface of the eyes. Adults have 20–35 thin, cycloid scales covering each eye between the pupil and interorbit. Juveniles have fewer scales, but all specimens of this species possess these scales.

In summary, *Bembrops macromma* has a low number of soft dorsal rays, usually 18 anal rays, and usually 25 pectoral rays. It has an intermediate number of lateral-line scales and a low number of vertebrae as does *B. heterurus*. Moreover, both *B. macromma* and *B. heterurus* are relatively stout-bodied forms. However, *B. macromma* has a shorter maxillary tentacle and also has a short snout and large orbit, whereas *B. heterurus* has a relatively long snout and a small orbit. *Bembrops macromma* has most of the anterior two membranes (rarely part of the third) blackened in the spinous dorsal fin (Fig. 1E) and *B. heterurus* has black pigmentation only in the anterior half of the first membrane.

Bembrops macromma has three short pyloric caeca, 5.6, 6.0, and 6.0 (left to right) % of SL, across the dorsal surface of the stomach.

Distribution/Depth.—Western Caribbean Sea on shelf along Honduras, Nicaragua, and Costa Rica; south side of Jamaica; north side of Cuba; three Bahama records—one from just south of Grand Bahama Island, one from southwestern edge of Great Bahama Bank, and one at Great Inagua Island; west and northwest of Puerto Rico (taken with *B. anatirostris*); and from northern Leeward Islands (Fig. 5). We cannot confirm Das & Nelson's (1996) Gulf of Mexico record (Fig. 12); this species appears to be absent from the Gulf of Mexico. Uyeno et al. (1983) include *B. macromma* as one of two species in the family occurring off Suriname and French Guiana. We have not been able to substantiate this, and Das & Nelson (1996) also did not include South America in their range of this species. Specimens of *Bembrops macromma* used in this study ranged from 192–512 m in depth, with most specimens taken between 250 and 400 m. Ginsburg (1955) reported the types of this species from 274 and 549 m and Grey (1959) found it at 438 and 457 m. Das & Nelson (1996) reported it between 150 and 550 m, with "most specimens below 250 m".

Material examined.—TU 12769 (2): Oregon 1341; 22°55′N, 79°16′W; 439 m; 16 Jul 1955. TU 12787 (1): Oregon 1341; 22°55′N, 79°16′W; 439 m; 16 Jul 1955. TU 18781 (3) and UF 202714 (5): Oregon 1879; 16°38′N, 81°39′W; 274 m; 22 Aug 1957 [pyloric caeca dissection]. TU 19933 (1): Oregon 1878; 16°39′N, 81°43′W; 230 m; 22 Aug 1957. TU 180136 (1): Oregon 1902; 11°27′N, 83°11′W; 247 m; 9 Sep 1957. UF 15615 (2): Oregon 3623; 16°08′N, 81°13′W; 192–201 m; 6 Jun 1962. UF 207119 (2): Oregon 2649; 18°12′N, 64°18′W; 274 m; 6 Oct 1959. UF 220555 (1): Gerda 692; 26°35′N, 78°25′W–26°34′N, 78°26′W; 21 Jul 1965. USNM 157983 (2): Oregon 1344, 22°50′N, 79°08′W; 366–411 m; 16 Jul 1955. USNM 304922 (4): Oregon 2658; 18°26′N, 67°11′30″W; 320 m; 7 Oct 1959. UF 47052 (2), USNM 304923 (8), USNM 304928 (2): Oregon 3549; 17°50′N, 77°52′W; 311 m; 16 May 1962. USNM 304925 (3), USNM 347204 (2): Oregon 10559; 23°04′N, 78°46′W; 347–377 m; 15 Dec 1969. USNM 304926 (5): Oregon 6699; 17°38′30″N, 62°16′W; 19 May 1967. USNM 304927 (3), USNM 342603 (2): Oregon 6700; 17°27′N, 62°04′W; 249–285 m; 19 May 1967. USNM 304929 (2): Oregon-II 10195; 14°17′N, 81°55′W; 329 m; 19 Nov 1968. USNM 342604 (1): Oregon 3625; 16°26′N, 81°35′W; 219 m; 6 Jun 1962. USNM 347205 (1): Oregon-II 10849; 20°50′N, 73°20′W; 311 m; 13 Dec 1969. CAS 61007 (2): Oregon-II 46095; 18°13′18″N, 67°19′30″W; 366 m; 21 Aug 1987. CAS 61010 (10): Oregon-II 46096; 18°13′30″N, 67°18′42″W; 357–384 m; 21 Aug 1987. CAS 61011 (1): Oregon-II 46062; 18°30′00″N, 65°42′12″W; 441–512 m; 15 Aug 1987.

Bembrops magnisquamis Ginsburg, 1955
Largescale duckbill

The small number (8) of specimens precludes much discussion and comparison. Dorsal fin formula is typically VI, 15 soft rays; anal fin has 17 rays; and pectoral fin ray counts are low, 22 to 24 (Table 1). Lateral-line scale counts are the lowest for any Atlantic *Bembrops*, ranging from 44 to 47 (Table 2). Gill raker counts are either 4 or 5 on upper limb, range from 13 to 16 on lower limb, and total counts range from 18 to 21 (Table 3). All eight specimens of *Bembrops magnisquamis* have 29 vertebrae, an intermediate number (Table 4). *Bembrops magnisquamis* has a relatively deep caudal peduncle and a very wide head (Table 8). Also, *B. magnisquamis* has a short snout and a large orbit, thus in three of the six specimens the orbit length is equal to length of snout and in the other three specimens the orbit length is greater than the snout (Table 9).

Bembrops magnisquamis has a relatively long maxillary tentacle in comparison to the other eight species considered in this study.

The anterior (first) membrane in the spinous dorsal fin is entirely black or with dark pigment at margin and base, with center of membrane clear. Membranes two and three are black on basal half and the pigmented basal portion is progressively less on succeeding membranes four and five. Membrane six is clear in all specimens examined (Fig. 1F). This spinous dorsal fin pigmentation of *B. magnisquamis* is distinct but has slight resemblance to two of the new forms described below. There is a thin dash of pigment along the midline of the nape just anterior to the spinous dorsal fin in *B. magnisquamis* that is not present in any other Atlantic *Bembrops*.

Distribution/Depth.—Type locality off S coast of Cuba; two sites in western Caribbean Sea, one off Honduras, one off Costa Rica; one locality in eastern Caribbean Sea, S of Puerto Rico (Fig. 4); other records (USNM) re-identified as *B. macromma.* We cannot confirm two records shown in Fig. 9, Das & Nelson (1996). Specimens of *Bembrops magnisquamis* used in this study ranged from 366–622 m. Ginsburg (1955) reported the types of the species from 366 and 465 m. Bullis & Struhsaker (1970) found *B. magnisquamis* between 368 and 640 m, with the highest densities in two depth strata, 368–457 m and 550–640 m. We examined one collection of *B. magnisquamis* taken with *B. anatirostris* off Costa Rica.

Material examined.—USNM 45985 and 108395, holotype and paratype as listed in Ginsburg (1955). TU 180138 (1): Oregon 1883; 16°52′N, 81°30′W; 366 m; 23 Aug 1957. USNM 304924 (4): Oregon 3574; 12°31′N, 82°21′W; 366 m; 23 May 1962. CAS 61008 (1): Oregon-II 46026; 17°44′42″N, 66°12′42″W; 366–622 m; 9 Aug 1987.

Bembrops ocellatus, new species
Ocellate duckbill
Fig. 7

Bembrops anatirostris.—Das & Nelson, 1996 (in part, locality in Caribbean Sea off Nicaragua).

Material.—39 specimens (93.2–187.5 mm SL) from 23 localities. Holotype.—TU 181281, a female 135 mm SL, Atlantic Ocean, off Venezuela, 09°17′N, 59°19′W, 503 m, 4 Nov 1957, Oregon Sta. 1992, 45′ trawl.

Paratypes.—TU 180353 (2): 117–126 mm SL, same data as holotype. TU 181668 (1): 91 mm SL, western Caribbean Sea, 16°41′N, 82°20′W, 549 m, 22 Aug 1957, Oregon Sta. 1872, 40′ flat trawl. CU 43877 (5): 97.0–146.0 mm SL, western Caribbean Sea, no locality data, May or Jun, 1962, Oregon Cruise 78, depth not known. UF 207128(1): 116 mm SL, eastern Caribbean Sea, off Venezuela, 11°36′N, 62°52′W, 394–421 m, 20 Apr 1960, Oregon Sta. 2780. USNM 307592 (3): 95.1–137.3 mm SL, Caribbean Sea off Nicaragua, 14°08′N,

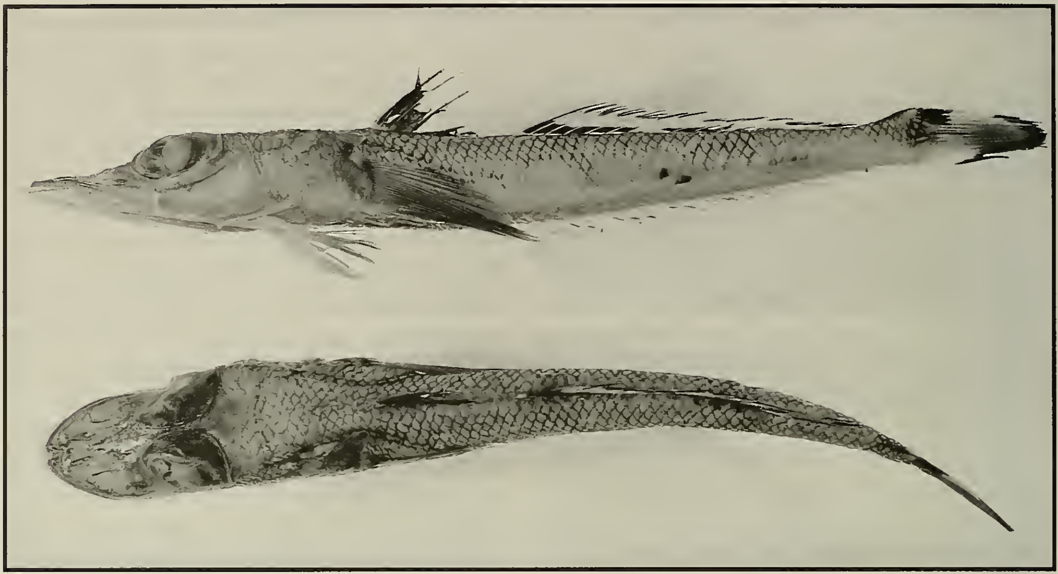

Fig. 7. *Bembrops ocellatus*, paratype, CAS 61006, 187.5 mm SL, female.

81°55′W, 366–439 m, 21 May 1962, Oregon Sta. 3570. USNM 344486 (3): 112.6–128.8 mm SL, Caribbean Sea off Venezuela, 11°49′N, 69°24′W, 549 m, 3 Oct 1963, Oregon Sta. 4412. USNM 347200 (1): 200 mm SL, Atlantic Ocean off Suriname, 07°27′N, 54°30′W, 201 m, 16 May 1962, Oregon-II Sta. 10622. USNM 347201 (1): 125.2 mm SL, Atlantic Ocean off Grenada, 12°01′N, 61°53.5′W, 384–457 m, 26 Sep 1964, Oregon Sta. 5043. USNM 347202 (1): 142.1 mm SL, Caribbean Sea off Nicaragua, 12°26′N, 82°24′W, 503 m, 2 Jun 1962, Oregon Sta. 3609. USNM 347214 (1): 156.5 mm SL, Caribbean Sea off Nicaragua, 13°39′N, 81°52′W, 503 m, 13 Sep 1957, Oregon Sta. 1923. USNM 347215 (2): 145.2–159.7 mm SL, Caribbean Sea off Colombia, 11°26′N, 74°14′W, 576 m, 3 Dec 1968, Oregon-II Sta. 10268. USNM 347216 (1): 169.4 mm SL, Atlantic Ocean N of St. Kitts & Nevis, 17°41′N, 62°50.5′W, 549–585 m, 18 May 1967, Oregon Sta. 6695. USNM 347217 (1): 144.0 mm SL, Atlantic Ocean NE off Dominica, 15°42′N, 61°08′W, 640 m, 1 Dec 1969, Oregon-II Sta. 10825. USNM 347254 (1): 143.0 mm SL, Caribbean Sea NW of Trinidad, 11°36′N, 62°42′W, 430 m, 19 Apr 1960, Oregon Sta. 2776. USNM 347261 (1): 93.2 mm SL, Caribbean Sea S of Jamaica, 17°40′N, 77°55′W, 530 m, 16 May 1962, Oregon Sta. 3552. USNM 347262 (1): 93.5 mm SL, Caribbean Sea W of St. Kitts & Nevis, 17°20′N, 62°52′W, 549–567 m, 30 Sep 1964, Oregon Sta. 5072. CAS 14632 (1): 123.2 mm SL, Caribbean Sea off Venezuela, 11°53′N, 69°28′W, 421 m, 28 Sep 1963, Oregon Sta. 4408, 40′ flat trawl. CAS 61006 (1): 187.5 mm SL, Atlantic Ocean off NE Puerto Rico, 18°31′12″N, 65°40′36″W, 439–512 m, 15 Aug 1987, Oregon-II Sta. 46061. CAS 150896 (1): 118.9 mm SL, Atlantic Ocean off Surinam, 07°34′N, 54°49′W, 411 m, 7 Nov 1957, Oregon 2007, 40′ flat trawl. CAS 98923 (1): 134.0 mm SL, Caribbean Sea, Lesser Antilles off St. Kitts and Nevis, 17°09′00″N, 66°44′48″W, 512–768 m, 4 Aug 1978, Oregon-II Sta. 24263.

Other materials.—USNM 347263 (1): 136.2 mm SL, Caribbean Sea W of Anguilla, 18°07′N, 63°20′W, 658 m, 7 Dec 1969, Oregon-II Sta. 10837. USNM 347264 (1): 140.4 mm SL, Caribbean Sea off Honduras, 16°51′N, 82°14′W, 585 m, 15 Nov

1968, Oregon-II Sta. 10176. USNM 347272 (3): 141.7–210 mm SL, Caribbean Sea off Venezuela, 10°57′N, 67°02′W, 457 m, 12 Oct 1963, Oregon Sta. 4454. USNM 347273 (3): 137.8–162.7 mm SL, SW Caribbean Sea off NW coast of Colombia, 10°16.2′N, 75°54.5′W, 549 m, 25 May 1964, Oregon Sta. 4882.

Diagnosis.—Dorsal fin usually VI-16 (rarely VI-15 or VI-17). Anal fin ranges from 16 to 19, usually 18. Pectoral fin usually 26, but varies from 25 to 27. Lateral-line scales 55–65, most often 58 to 63, $\bar{X} = 60.2$. Gill rakers usually 5 on upper limb, usually 15 on lower limb, and total count usually 20. Vertebral number usually 30 (29 in two). Ratio of head width divided by depth of head ranges from 1.3 to 1.6, usually 1.4, $\bar{X} = 1.43$. Snout short, usually slightly shorter, equal to or slightly longer than length of orbit (eye). Maxillary tentacle short, averaging only 2.6% of SL. The lateral-line has a moderately steep slope, reaching its lowest point under spines 5 or 6 of the first dorsal fin. *Bembrops ocellatus* possesses two (rarely four) wide black dorsal saddles, located under the posterior portion of the second dorsal fin at rays 10–13, and on the posterior part of the caudal peduncle at the start of the secondary caudal fin rays, sharing this character only with *B. quadrisella* and *B. raneyi* in the Atlantic members of the genus, but differing from both *B. quadrisella* and *B. raneyi* in that the anterior two saddles, when present, are usually less defined than the posterior two saddles.

Description.—*Bembrops ocellatus* is most similar to *B. gobioides*, *B. quadrisella*, and *B. raneyi*, having high scale, fin-ray, and vertebral counts (Tables 1–4). *Bembrops ocellatus* lacks the intense black, 'x' and 'v' secondary scale pigment that characterizes *B. gobioides*. *Bembrops ocellatus* lacks a black band in the anal fin, differing from *B. anatirostris*, *B. heterurus*, *B. macromma*, and *B. quadrisella* whose males have a black band in the anal fin. *Bembrops ocellatus*, similar to *B. raneyi*, but differing from all other Atlantic *Bembrops*, possesses a black "ocellus" spot at the dorsal base of the caudal fin in both sexes, although some males of this species have a basicaudal spot that is not an ocellus. *Bembrops ocellatus* has a black band in the distal part of the second dorsal fin and black at the base of rays 1–5 and 9–13, corresponding to where the dorsal body saddles are located. In larger specimens, the black forms two bands on the fin. This species lacks the elongate dorsal spine found in male *B. anatirostris* and scaled eyes, unique to *B. macromma*. *Bembrops ocellatus* never possesses vertically-oriented lateral markings, sometimes found in *B. greyi*, *B. heterurus*, and *B. macromma*.

The first dorsal fin pigmentation is distinct. There are two separate jet-black blotches, one at distal, anterior part of fin and a larger basal blotch. The wedge-shape, distal blotch is broadest across the first membrane, narrows progressively across second membrane, and its narrowed point extends halfway across the third membrane. The basal blotch broadens progressively from anterior, proximal third of first membrane to posterior half of third membrane, then the distal edge of blotch dips toward the base of the sixth spine, leaving most of the last membrane clear (Fig. 1G).

Bembrops ocellatus tends to have a larger eye in relation to the snout with 82.2% of specimens having snout/eye ratio less than, or equal to, one; whereas *B. quadrisella* has a somewhat longer snout with 93.1% of specimens having a snout/eye ratio greater than, or equal to, one. There is, however, considerable overlap.

Distribution/Depth.—Atlantic Ocean off eastern coast of Venezuela (type locality); widely distributed in the Caribbean Sea: along the coast of Venezuela, off Costa Rica, Nicaragua, and Honduras, near Puerto Rico and along many islands of the Lesser Antilles (Fig. 8). We examined seven collections where *Bembrops ocellatus* was taken with *B. quadrisella*. *Bembrops ocellatus* is found from 394 to 549 m depth.

Etymology.—The genus *Bembrops* is

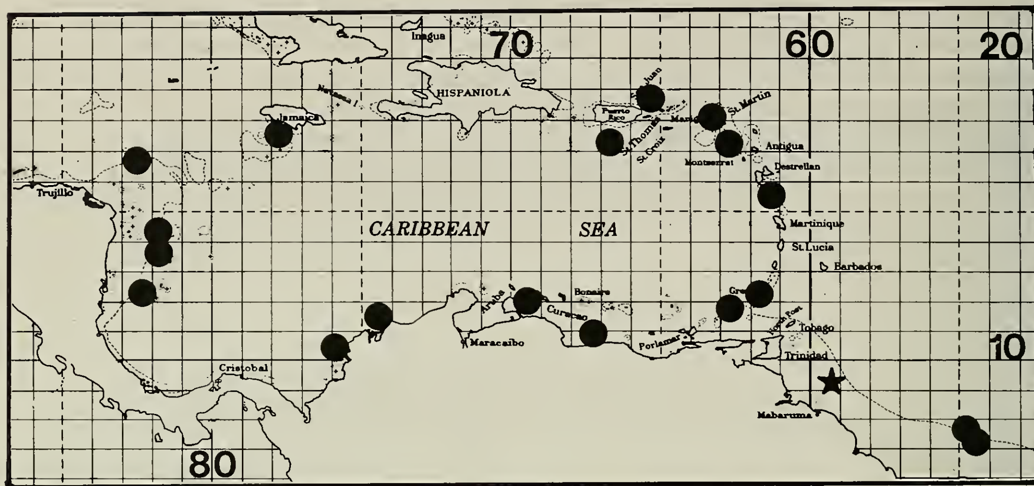

Fig. 8. Distribution of *Bembrops ocellatus* (●) based on specimens examined in this study. Type locality (★).

treated as masculine; the species name *ocellatus* is from the Latin word "ocellus", meaning a little eye (Jaeger 1966) referring to the black spot on the dorsal base of the caudal fin.

Bembrops quadrisella, new species
Saddleback duckbill
Fig. 9

Bembrops anatirostris.—Das & Nelson, 1996 (in part, locality in Caribbean Sea off Nicaragua).

Bembrops gobioides.—Das & Nelson, 1996 (in part, locality in Lesser Antilles).

Material.—123 specimens (101.2–231.0 mm SL) from 32 localities. Holotype.—TU 180351, a female 195 mm in SL, Atlantic Ocean, off Suriname, 07°38′N, 54°43′W, 457 m, 7 Nov 1957, Oregon Sta. 2008, 40′ trawl, bottom listed as "blue mud".

Paratypes.—TU 181667 (1): 178 mm SL, same data as holotype. TU 180350 (1): 159 mm SL, Atlantic Ocean, off Suriname, 07°34′N, 54°49′W, 411 m, 7 Nov 1957, Oregon Sta. 2007. TU 180259 (1): 127 mm SL, western Caribbean Sea, off Nicaragua, 16°39′N, 82°26′W, 457 m, 22 Aug 1957, Oregon Sta. 1871. TU 180353 (1): 145 mm SL, western Caribbean Sea, 16°41′N, 82°20′W, 549 m, 22 Aug 1957, Oregon Sta. 1872. TU 20037 (1): 185 mm SL, eastern Caribbean Sea, 11°35′N, 62°41′W, 388–457 m, 23 Sep 1958, Oregon Sta. 2353. CU 43863 (1): 227 mm SL, western Caribbean Sea, no locality data, May or Jun 1962, Oregon Cruise 78. CU 77466 (1): 163 mm SL, western Caribbean Sea, no locality data, May or Jun 1962, Oregon Cruise 78. USNM 304913 (4): 127.2–211 mm SL, Caribbean Sea off Nicaragua, 12°26′N, 82°24′W, 503 m, 2 Jun 1962, Oregon Sta. 3609. USNM 304917 (2): 192–235 mm SL, Atlantic Ocean NE of Dominica, 15°39′N, 61°10′W, 649 m, 5 Mar 1966, Oregon Sta. 5929. USNM 347206 (4): 139.8–168.0 mm SL, Caribbean Sea off Nicaragua, 14°10′N, 81°55′W, 439–457 m, 21 May 1962, Oregon Sta. 3565. USNM 347207 (3): 154.2–162.6 mm SL, Caribbean Sea off Honduras, 14°10′N, 81°50′W, 549–604 m, 21 May 1962, Oregon Sta. 3571. USNM 347208 and 347258 (2): 182–231 mm SL, Lesser Antilles, 17°06′N, 62°17′W, 589 m, 8 Dec 1969, Oregon-II Sta. 10843. USNM 347209 (1): 222 mm SL, Atlantic Ocean off Dominica, 15°36′N, 61°13′W, 503 m, 4 Mar 1966, Oregon Sta. 5926. USNM 347210 (2): 173–205 mm SL, Caribbean Sea E of

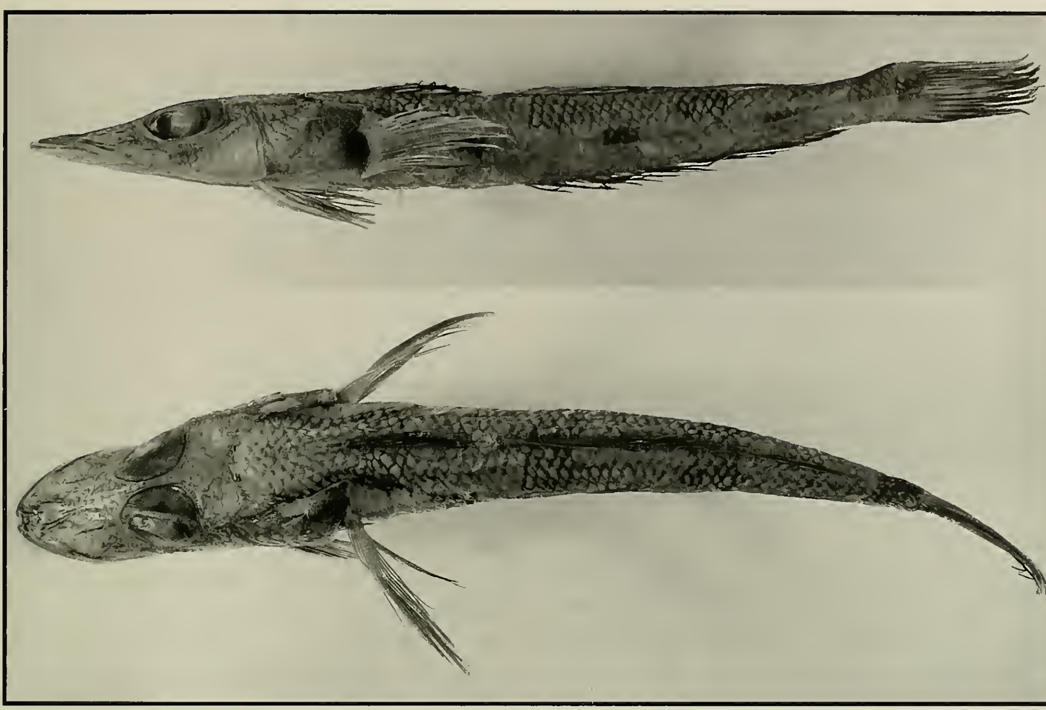

Fig. 9. *Bembrops quadrisella*, paratype, CAS 61004, 197.5 mm SL, male.

St. Croix, 17°42′N, 63°58′W, 741 m, 3 Dec 1969, Oregon-II Sta. 10832. USNM 347211 (2): 200–201 mm SL, eastern Caribbean Sea, 11°40′N, 62°33′W, 585–621 m, 24 Sep 1964, Oregon Sta. 5039. USNM 347218 (11): 101.2–189.5 mm SL, Caribbean Sea off Costa Rica, 12°25′N, 82°15′W, 549–585 m, 23 May 1962, Oregon Sta. 3576. USNM 347219 (1): 192.5 mm SL, Caribbean Sea off Venezuela, 11°53′N, 69°28′W, 421 m, 28 Sep 1963, Oregon Sta. 4408. USNM 347220 (6): 170.4–228 mm SL, Atlantic Ocean NE off Dominica, 15°42′N, 61°08′W, 640 m, 1 Dec 1969, Oregon-II Sta. 10825. USNM 347221 and 347256 (3): 176.0–230 mm SL, Atlantic Ocean N of St. Kitts & Nevis, 17°41′N, 62°50.5′W, 549–585 m, 18 May 1967, Oregon Sta. 6695. USNM 347255 (1): 215 mm SL, Caribbean Sea E of St. Croix, 17°36′N, 63°32′W, 439–476 m, 30 Sep 1959, Oregon Sta. 2636. USNM 347257 (1): 204 mm SL, Atlantic Ocean NE of St. Croix, 18°18′N, 63°24′W, 658 m, 10 Dec 1969, Oregon-II Sta. 10847. USNM 347259 (1): 149.2 mm SL, Caribbean Sea off Venezuela, 10°54′N, 67°08′W, 402 m, 12 Oct 1963, Oregon 4453. USNM 347260 (11): 113.1–190.5 mm SL, Caribbean Sea off Honduras, 16°58′N, 87°53′W, 457–732 m, 10 Jun 1962, Oregon Sta. 3635. USNM 347266 (11): 130.0–188.0 mm SL, Caribbean Sea off Honduras, 16°51′N, 82°14′W, 585 m, 15 Nov 1968, Oregon-II Sta. 10176. USNM 347267 (10): 132.2–162.0 mm SL, Caribbean Sea off Costa Rica, 12°35′N, 82°19′W, 457 m, 23 May 1962, Oregon Sta. 3575. USNM 347268 (5): 130.9–158.1 mm SL, Caribbean Sea off Honduras, 16°44′N, 87°55′W, 347 m, 9 Jun 1962, Oregon Sta. 3634. USNM 347269 (8): 120.0–223 mm SL, Caribbean Sea SE of Puerto Rico, 17°40′N, 63°40′W, 658–695 m, 30 Sep 1959, Oregon Sta. 2637. CAS 56879 (1): 205 mm SL, Caribbean Sea, Lesser Antilles off St. Kitts and Nevis, 17°09′00″N, 66°44′48″W, 512–768 m, 4 Aug 1978, Oregon-II Sta. 24263. CAS 61004 (2): 134.0–197.5 mm SL, Atlantic Ocean, U.S. Virgin Islands, N of St. Thomas Island, 18°32′42″N, 65°42′00″W, 732–777 m, 16 Aug 1987, Oregon-II Sta. 46067, 65′ trawl. CAS 61005 (1): 205 mm SL, Atlantic Ocean, Puerto Rico, NW coast off Bahir de Aquadilla, 18°26′42″N, 67°14′42″W, 658–668 m, 21 Aug 1987, Oregon-II Sta. 46094.

Other materials.—USNM 347270 (3): 147.1–192 mm SL, Caribbean Sea off Venezuela, 11°10′N, 68°08′W, 402 m, 11 Oct 1963, Oregon Sta. 4451. USNM 347271 (17): 114.7–184 mm SL, Caribbean Sea off Nicaragua, 17°02′N, 81°27′W, 549–585 m, 7 Jun 1962, Oregon Sta. 3629. CAS 47193 (1): 175 mm SL, Caribbean Sea off Venezuela, 12°48′N, 70°10′W, 366–914 m, 26 Feb 1973, Oregon-II Sta. 129. CAS 56927 (1): 188 mm SL, Caribbean Sea, Lesser Antilles off St. Kitts and Nevis, 17°15′54″N, 62°16′48″W, 567–640 m, 5 Aug 1978, Oregon-II Sta. 24265.

Diagnosis.—Dorsal fin usually VI-16 (82% of specimens). Anal fin 17 or 18, rarely 16 or 19. Pectoral rays usually 26 or 27, sometimes 25 or 28. Lateral-line scales 57–65, $\bar{X}$ = 61.1. Gill rakers always 5 on upper limb, usually 15 or 16 on lower limb, and usually a total count of 20 or 21. Vertebral number usually 30 (29 in six). Ratio of head width divided by depth of head ranges from 1.2 to 1.5, usually 1.4, $\bar{X}$ = 1.39. Upper and lower jaw moderately long, and postorbital distance also moderately long. Snout short, equal to or slightly greater than length of orbit (eye). Maxillary tentacle short, averaging only 2.1% SL. The lateral-line has a gentle slope, descending gradually to the straight portion under the space between the two dorsal fins or under the anterior rays of the second dorsal fin. *Benbrops quadrisella* possesses four wide black dorsal saddles, located at the origin of the spinous dorsal fin, under rays 2–6 of the second dorsal fin, under rays 10–13 of the second dorsal fin, and on the posterior part of the caudal peduncle at the start of the secondary caudal fin rays, sharing this character with *B. raneyi*.

Description.—*Bembrops quadrisella* is most similar to *B. gobioides*, *B. ocellatus*, and *B. raneyi*, having high scale, fin-ray, and vertebral counts (Tables 1–4). *Bembrops quadrisella* lacks the intensive black 'x' and 'v' secondary scale pigment that characterizes *B. gobioides*. Male *B. quadrisella* have the distal ½ to ⅔ of the anal fin black, similar to *B. anatirostris*, *B. heterurus*, and *B. macromma*; other Atlantic *Bembrops*, *B. greyi*, *B. gobioides*, *B. magnisquamis*, *B. ocellatus*, and *B. raneyi* have clear or slightly dusky fins, without broad black bands in either sex. *Bembrops quadrisella* is the only Atlantic species in the genus possessing white pigment in the spinous and second dorsal, anal, and pectoral fins. Female *B. quadrisella* possess a black "ocellus" spot at the dorsal base of the caudal fin, differing from *B. anatirostris*, *B. heterurus*, *B. macromma*, and *B. magnisquamis* that lack ocelli in both sexes, but is similar to *B. greyi* and *B. gobioides*, where females also possess an ocellus, but differing from *B. ocellatus* and *B. raneyi* that have a basicaudal spot in both sexes. *Bembrops quadrisella* lacks black bands in the second dorsal fin, having small intense black marks only at the base of several anterior rays. This species lacks the elongate spine found on male *B. anatirostris* and scaled eyes, unique to *B. macromma*. *Bembrops quadrisella* never possesses vertically-oriented lateral blotches, sometimes found in *B. greyi*, *B. heterurus*, and *B. macromma*.

The first dorsal fin pigmentation of female *B. quadrisella* is distinct (Fig. 1H). There is a small spot of black at base of first membrane and a black, submarginal band, broader on first two membranes and then a narrowed band extending across third, fourth, fifth, and sixth membranes. The greater part of the fin is either clear or lightly sprinkled with melanaphores. Male *B. quadrisella* usually have a first dorsal fin pattern similar to the female, but some specimens lack this distinctive pattern, pos-

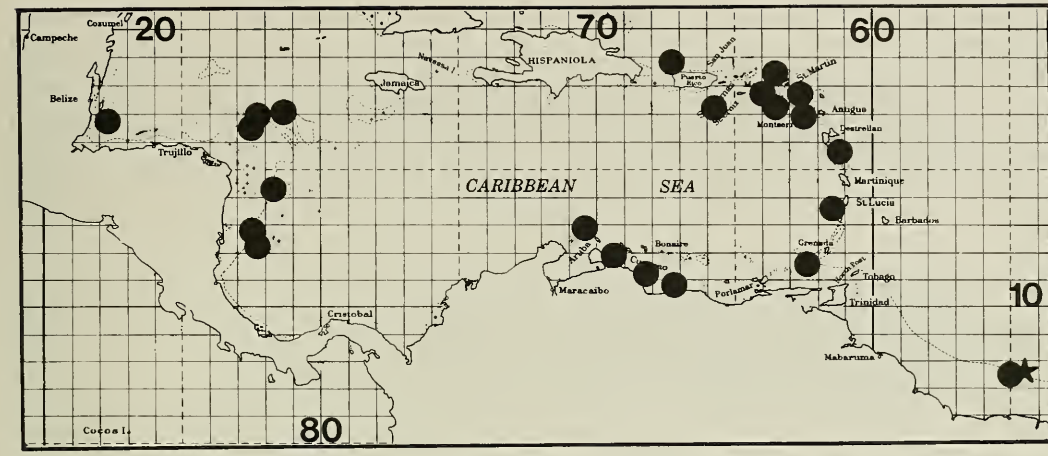

Fig. 10. Distribution of *Bembrops quadrisella* (●) based on specimens examined in this study. Type locality (★).

sessing only a light wash of melanophores over the entire fin.

Distribution/Depth.—Atlantic Ocean off Suriname (type locality; second site near type locality; widely distributed in the Caribbean Sea: along the coast of Venezuela; off Costa Rica, Nicaragua, and Honduras; S of Jamaica; near Puerto Rico and along length of Lesser Antilles (Fig. 10). We examined seven collections where *Bembrops quadrisella* was taken with *B. ocellatus* and one collection taken with *B. anatirostris. Bembrops quadrisella* is found from 347 to 914 m, usually between 400 and 600 m.

Etymology.—The species name *quadrisella* is from the Latin "quadrus", meaning fourfold or four, and "sella", a seat or saddle (Jaeger 1966) in reference to the four well-developed saddles on the dorsum of the body.

Bembrops raneyi, new species
Bahama duckbill
Fig. 11

Material.—Twenty nine specimens (69.0–176.0 mm SL) from ten localities. Holotype.—TU 180135, a male 136 mm SL, Atlantic Ocean, just east of Cay Sal Bank, 23°59′N, 79°43′W, 640 m, 24 Jul 1957; Combat Sta. 450; 10′ beam trawl.

Paratypes.—CU 77467 (1): 110 mm SL, TU 16849 (6): 69.0–145.0 mm SL; same data as holotype. TU 180260 (4): 107.0–164.0 mm SL; Atlantic Ocean, E of Vero Beach, Florida and north of Matanilla Shoal light; 27°53′N, 79°09′W; 686–759 m; 9 Jun 1958; Silver Bay Sta. 442; 40′ flat trawl. UF 212111 (1): 137.4 mm SL; Atlantic Ocean, Bahama Islands, Elbow Bank, W of Cat Cay, 26°27′N, 79°21′W–26°36′N, 79°24′W; 531–540 m; 25 Jun 1963; Gerda Sta. 158; otter trawl. UF 217644 (1): 125.1 mm SL; Atlantic Ocean, Bahama Islands, Elbow Bank, W of Alice Town, Bimini Island, 25°49′N, 79°21′W–25°53′N, 79°22′W; 284–293 m; 1 Jul 1965; Gerda Sta. 646. UF 220553 (1): 167.3 mm SL; Atlantic Ocean, Grand Bahama Island, S of Freeport, 26°26′N, 78°39′W–26°27′N, 78°41′W; 724 m; 22 Jul 1965; Gerda Sta. 709. UF 220554 (1): 109.9 mm SL, Atlantic Ocean, Bahama Islands, NW of Berry Islands, 25°56′N, 78°09′ to 05′W; 595–711 m; 20 Jul 1965; Gerda Sta. 679. USNM 269552 (4): 93.0–146.8 mm SL and one cleared and stained, 115.0 mm SL; Atlantic Ocean, off Nassau, exact locality uncertain, probably 26 Oct 1961; Silver Bay Sta. 3479. USNM 347223 (5): 82.9–151.7 mm SL; Atlantic Ocean in Straits of Florida, 23°09′N, 80°08′W; 466

Fig. 11. *Bembrops raneyi*, paratype, USNM 347223, 141.7 mm SL, male.

m; 16 Dec 1969; Oregon-II Sta. 10863. USNM 347252 (3): 104.4–176.0 mm SL; Atlantic Ocean in Straits of Florida; 23°59'N, 79°17'W; 530–549 m; 17 Nov 1960; Silver Bay Sta. 2469. USNM 347253 (1): 117.0 mm SL; Atlantic Ocean in Straits of Florida, 23°40'N, 79°18'W; 530 m; 5 Nov 1960; Silver Bay Sta. 2458.

Diagnosis.—Dorsal fin usually VI-16 (VI-15 in three, VI-17 in one). Anal fin usually 18 (17 in nine). Pectoral fin 25–29, usually 27. Lateral-line scales 56–61, $\bar{X}$ = 59.0. Gill rakers usually 5 on upper limb, 14 on lower limb, and total number usually 19. Vertebral number usually 30 (29 in two). Maxillary tentacle a long triangle, averaging 4.1% SL. Head very broad, width averages 1.5 times its depth. Snout short, slightly longer or shorter than orbit. Upper, lower jaws and postorbital lengths moderately short. The lateral-line has a relatively gentle slope reaching its lowest point between the two dorsal fins. Body pale. First dorsal fin with two black blotches, the smaller, a narrow submarginal bar spanning the first two membranes, the larger extending along base of fin, crossing the first to fourth membranes. The interspace between the distal and basal blotches is clear (Fig. 11). *Bembrops raneyi* possesses four wide dark dorsal saddles, located at the origin of the spinous dorsal fin, under rays 2–6 of the second dorsal fin, under rays 10–13 of second dorsal fin, and on the posterior part of the caudal peduncle at the start of the secondary caudal fin rays, sharing this character with only *B. quadrisella.*

Description.—Bembrops raneyi is most similar to *B. gobioides*, *B. ocellatus*, and *B. quadrisella*, having high scale, fin-ray, and vertebral counts (Tables 1–4). *Bembrops raneyi* lacks the dark black 'x' and 'v' secondary scale pigment that characterizes *B. gobioides* and *B. greyi. Bembrops raneyi* lacks both scaled eyes as found in *B. macromma* and elongate second dorsal spine of *B. anatirostris. B. raneyi* lacks black bands in the anal fin, distinguishing it from *B. anatirostris*, *B. heterurus*, *B. macromma*, and *B. quadrisella* whose males possess black in the anal fin. Both sexes of *B. raneyi* have a dorsally-placed, basicaudal spot; the only other Atlantic *Bembrops* sharing this character is *B. ocellatus. Bembrops raneyi* never possesses vertically-ori-

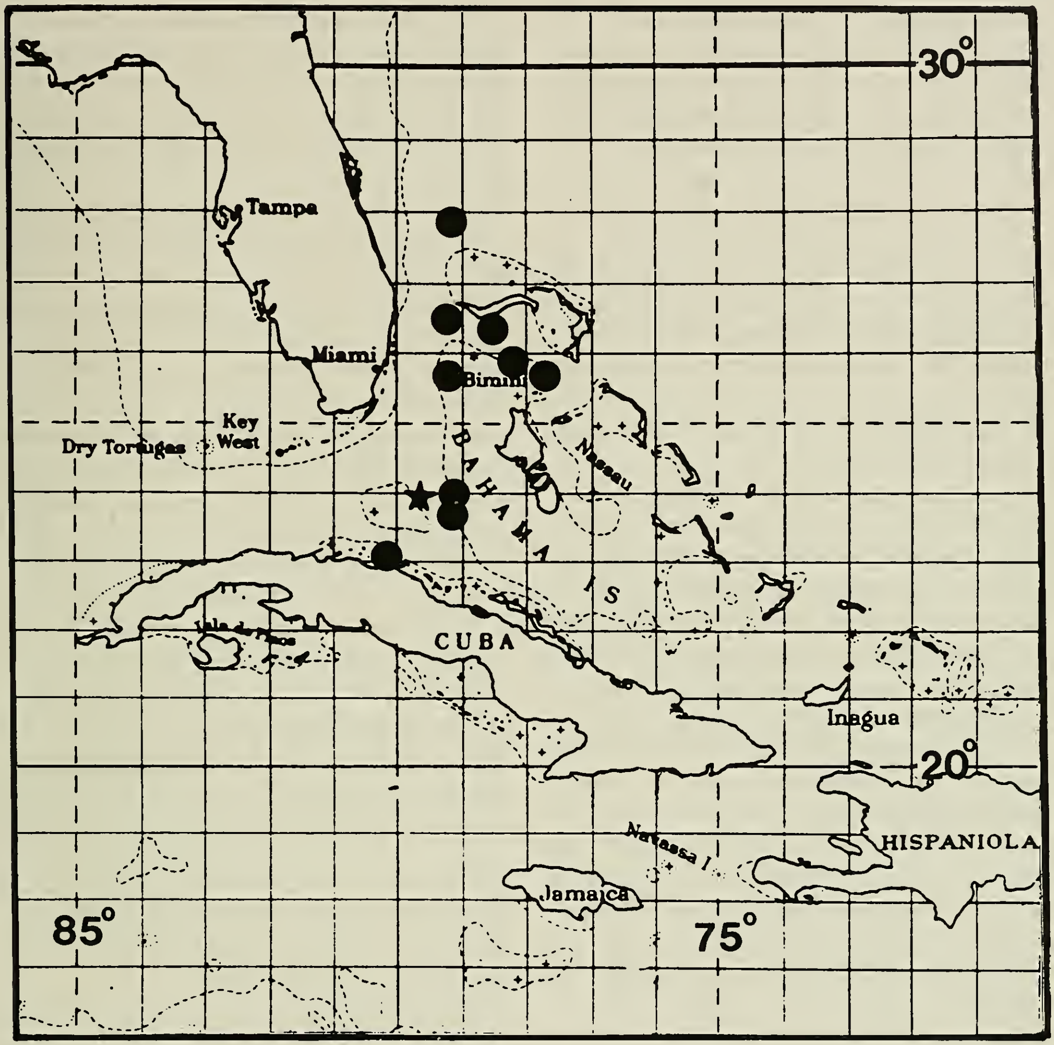

Fig. 12. Distribution of *Bembrops raneyi* (●) based on specimens examined in this study. Type locality (★).

ented lateral markings as sometimes found in *B. greyi*, *B. heterurus*, and *B. macromma*.

Bembrops raneyi has three very short pyloric caeca, 2.6, 3.9, and 3.4 (left to right) % of SL, across the stomach. These are the shortest caeca of any Atlantic species examined in the genus *Bembrops*. *Bembrops raneyi* has the longest tentacle for any Atlantic species of *Bembrops* except for *B. anatirostris* (Table 10).

Distribution/Depth.—Atlantic Ocean in western, southwestern and northwestern Bahamas Islands; (Fig. 12), three species of *Bembrops: B. anatirostris*, *B. macromma*, and *B. gobioides* have been taken in area near records of *B. raneyi*. *Bembrops raneyi* is one of the deeper dwelling species in the genus, being found from 284 to 759 m, with most specimens taken below 500 m.

Etymology.—We take great pleasure in naming this species after the late Dr. Edward C. Raney, former Professor of Ichthyology at Cornell University and teacher to many of North America's ichthyologists, our mentor, friend, and professional colleague, who had a long-standing interest in percophids and organized much of the study materials we have used in the present research. We made use of his notes, and an early draft of a manuscript describing the species that now bears his name.

Discussion

Our counts and measurements agreed, for the most part, with those of Ginsburg (1955). Our interpretation of the structural bases of the fin rays was verified by numerous x-rays. Our counts of 113 *B. anatirostris* resulted in eight with 14 dorsal rays and 105 with 15 dorsal rays.

Bembrops anatirostris and *B. gobioides* have the highest lateral-line scale counts of the nine species of *Bembrops* from the Atlantic Ocean. Both males and females display a silvery sheen on the prepectoral area and for a varying distance forward on side of isthmus. None of the other seven species was observed to have such coloration. *Bembrops anatirostris* and *B. gobioides* differ, however, in several characteristics. Previous studies have noted the elongate dorsal spine of *B. anatirostris.* Ginsburg (1955) and Grey (1959) stated that the second dorsal spine of male was prolonged, however Das & Nelson (1996) stated that the second or third spine of the male was produced. We found no male *B. anatirostris* with prolonged third dorsal spine, all were second dorsal spines. *Bembrops anatirostris* usually has 15 dorsal rays whereas *B. gobioides* usually has 17 dorsal rays; *B. anatirostris* invariably has 28 vertebrae whereas *B. gobioides* usually has 30. *Bembrops anatirostris* has a greater head, and caudal peduncle depth than *B. gobioides. Bembrops anatirostris* has a greater head length, head width, snout length, jaw length, and postorbital length than *B. gobioides. Bembrops anatirostris* has a smaller orbit relative to snout length and a very long attenuate maxillary tentacle in comparison to *B. gobioides* which has a larger orbit that is sometimes equal to snout length, especially in small juveniles and has a maxillary tentacle of moderate length. In addition to these differences, there are a number of differences in pigmentation of fins and body that are described above in the species accounts.

Bembrops macromma and *B. magnisquamis* were the only two previously known western north Atlantic forms possessing medium to large scales. These two forms differ markedly in a number of ways. Unfortunately, we have only eight specimens of *B. magnisquamis* to compare with *B. macromma. Bembrops macromma* invariably has 14 dorsal rays, usually 18 anal rays, and usually 25 pectoral rays, whereas *B. magnisquamis* has usually 15, occasionally 16 dorsal rays, 17 anal rays and either 23 or 24 pectoral rays. The number of lateral-line scales range from 53 to 61 in *B. macromma* vs. 44 to 47 in *B. magnisquamis. Bembrops macromma* usually has 28 vertebrae, occasionally 27 whereas *B. magnisquamis* has 29. *Bembrops macromma* has a greater head and body depth, but a similar caudal peduncle depth as *B. magnisquamis. Bembrops macromma* has the shortest maxillary tentacle of the nine species of *Bembrops* included in this study in contrast to *B. magnisquamis* which has a moderately long maxillary tentacle. Pigmentation differences are described in detail in the species accounts.

Bembrops ocellatus, *B. quadrisella*, and *B. raneyi* are quite similar in most meristics and morphometrics. These three new species typically have 16 dorsal rays and 18 anal rays, but occasionally have 15 of the former and 17 of the latter. *Bembrops ocellatus* and *B. quadrisella* typically have 26 pectoral rays whereas *B. raneyi* usually has 27 pectoral rays. *Bembrops ocellatus* and *B. quadrisella* have more lateral-line scales, 60 to 63 in former and 59 to 64 in the latter; *B. raneyi* with a lower count, 56 to 61. All three species usually have five gill rakers on upper limb, but *B. ocellatus* and *B. quadrisella* usually have 15 rakers on lower limb and *B. raneyi* usually has 14 rakers on lower limb, so total gill raker counts usually are 20 for *B. ocellatus* and *B. quadrisella* but 19 for *B. raneyi*. *Bembrops raneyi* has slightly greater body depth, less head depth, greater head width, and greater orbit length relative to snout length than the other two species. *Bembrops quadrisella* has a greater head length, greater head depth, greater snout length, greater upper jaw, lower jaw, and postorbital lengths than either *B. ocellatus* or *B. raneyi*. *Bembrops raneyi* has the longest maxillary tentacle, *B. ocellatus* the next longest, and *B. quadrisella* the shortest maxillary tentacle of the three new species. The maxillary tentacle of *B. raneyi* is slightly shorter than that of *B. anatirostris*, and the tentacle of *B. quadrisella* is only slightly longer than that of *B. macromma*. There are some distinct pigmentation patterns of fins and body but these are described above in detail.

We discuss *B. greyi* and *B. heterurus* together because our samples of both species are from the eastern Atlantic and both species have a general appearance distinct from the seven western north Atlantic species. These two species are quite easily separated: *Bembrops greyi* usually has 16 dorsal rays, *B. heterurus* usually has 15; *B. greyi* usually has either 17 or 18 anal rays, *B. heterurus* typically has 18. *Bembrops greyi* usually has 26 pectoral rays, whereas *B. heterurus* usually has 27. *Bembrops greyi* has a range in lateral-line scale counts from 45 to 52, whereas *B. heterurus* ranges from 55 to 60. There are fewer gill rakers in *B. greyi* than in *B. heterurus*. *Bembrops greyi* typically has 30 vertebrae whereas *B. heterurus* usually has 28. Das & Nelson (1996) reported *B. heterurus* from the western Atlantic with 17 anal rays (84% of specimens), differing from our findings from eastern Atlantic specimens with specimens having 18 anal rays (92% of specimens). Das & Nelson's (1996) analysis of western south Atlantic *Bembrops heterurus* shows that nearly all proportions of this species differed from our observations on the eastern Atlantic populations (considered *B. heterurus* by Poll (1959)), suggesting that the eastern Atlantic form is an undescribed species.

Bembrops heterurus has a greater body depth, greater head depth, greater head width, greater interorbital width, and greater snout length than *B. greyi*. *Bembrops greyi* has a greater head length and greater orbit length than *B. heterurus*. The relative length of snout versus length of orbit reveals that the orbital horizontal distance is usually greater than the snout length in *B. greyi* but never greater than or equal to snout length in *B. heterurus*. The maxillary tentacle is of moderate size in both *B. greyi* and *heterurus*.

There has been little discussion concerning sexual dimorphism in the Atlantic members of the genus *Bembrops*. Ginsburg (1955) noted the prolongation of the second dorsal spine in "larger males" of *B. anatirostris*. Grey (1959) also noted this sexual dimorphism in *B. anatirostris* and suggested "it is possible that other species may also exhibit sexual dimorphism", but provided no further observations. Ginsburg (1955:631) noted "the smaller specimens (referring to the genus *Bembrops*) having a spot on the caudal near its base, nearer to upper than lower margin, disappearing with growth . . .". Our observations on series of the Atlantic species of *Bembrops* shows this statement to be partially correct. All small specimens of *B. gobioides* and *B. greyi* possess an ocellus as described by Ginsburg (1955), however this mark is retained in adult females, but faded or completely lost in adult males. *Bembrops quadrisella* is also sexually dimorphic in females having a caudal spot that the males lack. Masuda et al. (1984) reported similar sexual dimorphism with the Pacific species, *B. caudimacula* and *B. filifera*. Two Atlantic species, *B. ocellatus* and *B. raneyi* and one Pacific species, *B. curvatura* have both sexes possessing a caudal spot. We find *Bembrops anatirostris*, *B. heterurus*, *B. macromma*, and *B. magnisquamis* lack a caudal spot for all life history stages. Das & Nelson (1996) reported that certain specimens of *Bem-*

brops species possess a caudal spot, but did not relate it to the sex of the specimen.

Bembrops anatirostris, *B. macromma*, and *B. quadrisella* are sexually dimorphic in anal fin pigment, with males having black in the fin that is lacking in females.

All species of *Bembrops* examined in this study are sexually dimorphic in genital papilla size; males having a longer and more robust, papilla, females having a much smaller papilla. This dimorphism in papilla sizes reaches an extreme in the Pacific species, *Bembrops curvatura*, whose males possess an elongate, club-shaped papilla, 2–3 times the length of the papilla of the female.

Most Atlantic *Bembrops* have a gentle slope to the lateral-line, descending to its lowest point on the body between the two dorsal fins. Interspecific variation of this character ranges from *B. heterurus* and *B. macromma* where the slope is so gradual that the straight section of the lateral-line starts under the anterior part of the second dorsal fin to *B. gobioides* that possesses an abrupt slope where the lateral-line descends to the straight section under the first dorsal fin. Among the new species, *Bembrops ocellatus* and *B. raneyi* have slightly steeper slopes to the lateral-line than *B. quadrisella.*

The nine species of Atlantic *Bembrops* have 27 to 30 vertebrae. Miller & Jurgenson (1973) listed precaudal, caudal and total counts for these species, but their values for *B. macromma* are partially in error. They report *Bembrops* normally having nine precaudal vertebrae, agreeing with our findings (except for an infrequent count of ten in *B. anatirostris*). Vertebral number seems to be a conservative character with little variation within most species (Table 4). What variation in vertebral number, within and between species, that does exist, results from differences in caudal vertebrae. This differs from *Chrionema*, the sister group to *Bembrops* (sensu Nelson 1994) since Iwamoto & Steiger (1976) report 19 caudal vertebrae in *Chrionema* and either 8 or 9 precaudal vertebrae for a total of 27 or 28.

We cannot agree with Das & Nelson's (1996) statement in the description of the genus that species of *Bembrops* possess "two small spinous processes on the posterior tip of posttemporal". In five species examined (Fig. 3) there is only a single prominent spine projecting dorso-posteriorly from the rear of the posttemporal bone. Just posterior and lateral to the posttemporal spine, a protuberance on the supracleithrum frequently projects through the epidermis suggesting the presence of a second spine near the anterior keeled lateral-line scale. Shape, size, and degree of curvature appears to vary among the species.

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